PUBLIC WORKS

Sept.
1953

Second Installment

SOIL
ENGINEERING

ıdustrial Waste
Problems In Cities

---

lsing Aerial Photography
in Highway Studies

---

liminating Water System
Cross-Connections

---

aking the Guesswork
Out of Trickling Filters

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ov· Good Planning Aids
Snow and Ice Control

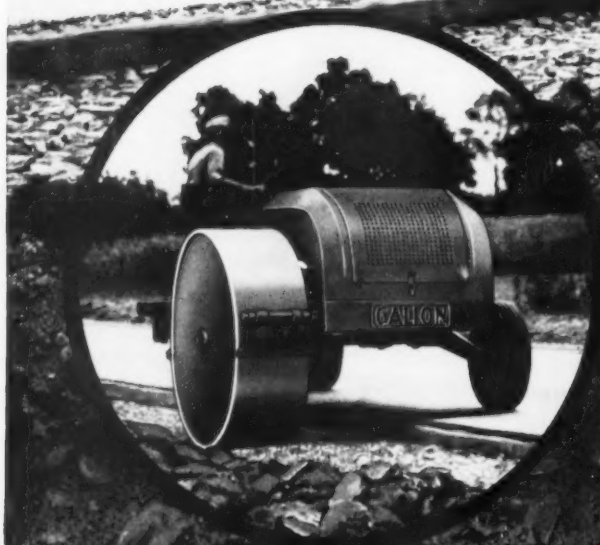
---

ewage Disposal
for a Subdivision

B. A. Poole is Director of the Bureau of Environmental Sanitation and Chief Sanitary Engineer of Indiana's Health Department. **More on page 28.**

GALION TRENCH ROLLER

SIMPLIFIES ROAD WIDENING JOBS



GALION — THE ORIGINAL

Galion originated the trench-type roller - - and is now the first to offer a completely new and improved design.

FEATURES

- Hydraulically controlled dual steering wheels.
- Adjusting and steering wheels travel on pavement.
- Works 25" below to 6" above road surface - - adjustment hydraulically controlled.
- Large diameter compression roll.
- Rugged, constant-mesh transmission and spur gear final drive.
- Powerful engine, completely enclosed under housing.

GALION

ESTABLISHED 1907 **MOTOR GRADERS • ROLLERS**

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CHICAGO SEWAGE EQUIPMENT

CHICAGO-SELAS HEAT TRANSFER SYSTEMS

A proven principle of high rate heat transfer

Maximum Efficiency, Minimum Maintenance

This widely used principle of direct, controlled heat transfer has found universal acceptance in industrial applications. It was developed by the Selas Corporation of America and first applied to sludge heating at the City of Philadelphia. Chicago Pump Company engineers and Selas combined their specialized knowledge to produce Chicago-Selas Heat Transfer Systems for sludge heating.

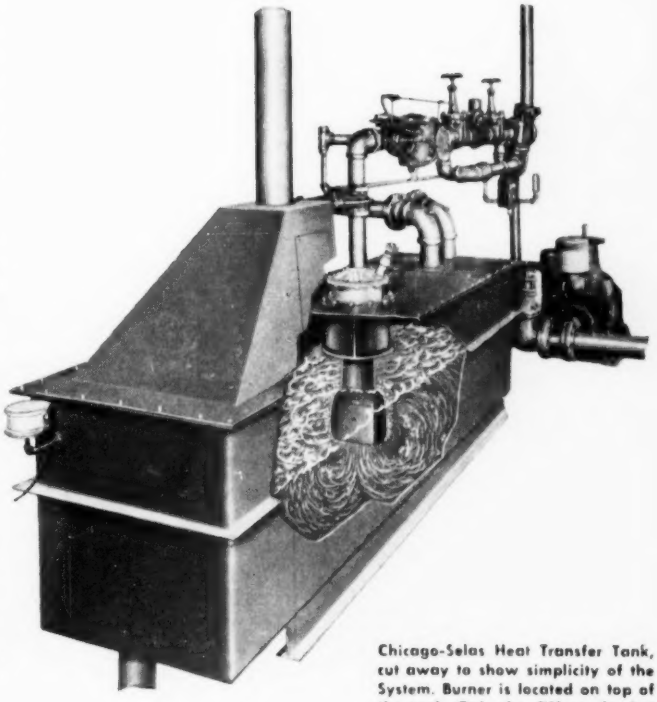
These systems provide positive high rate direct heat transfer from hot gases of combustion to sludge. A 10 to 20 Degree F. temperature rise in the sludge is accomplished in one pass through a small heat transfer tank. Approximately 90% of the heat available in the digester gas is directly transferred to the sludge. The heat available per cubic foot per hour of combustion space is up to 200 times that provided by ordinary combustion methods used in digester heat exchangers. This high rate of temperature rise is accomplished with precise temperature control.

Hot gases of combustion produced in the burner are expelled at the rate of about 30 fps. This causes great agitation and thorough mixing of the sludge in the heat transfer tank. This rapid agitation and mixing throughout the sludge insures efficient and thorough direct heat transfer through the sludge.

Because heating is accomplished in a tank, there are no sludge tubes to cake or clog—no labor for cleaning.

In medium size plants there is frequently only sufficient gas production for use in either gas engines or sludge heating. The high efficiency of the Chicago-Selas System permits the use of gas in both applications. This is accomplished by placing heat exchange tubes in the sludge heating tank.

All gas control and safety equipment is approved by Associate Factory Mutual Fire Insurance Companies.



Chicago-Selas Heat Transfer Tank, cut away to show simplicity of the System. Burner is located on top of the tank. Only the diffuser for hot gas extends into the sludge.

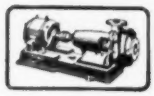
ADDED ADVANTAGES of Chicago-Selas . . . Heat distributed without mechanical equipment in digester • Heat transfer efficiency is constant regardless of length of operation • Heated digesters now practical for both new or existing small plants • Operates efficiently on nationally available stand-by manufactured gas • Minimum variation in sludge temperature from top to bottom of tank • Easily accessible for service • Heater and transfer tank may be located at digester, requiring minimum piping and valves.

CHICAGO PUMP COMPANY

SEWAGE EQUIPMENT DIVISION

622 DIVERSEY PARKWAY **CHICAGO 14, ILLINOIS**

Flush Kleen, Scru-Peller, Plunger, Horizontal and Vertical Non-Clog Water Seal Pumping Units, Samplers.



Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clarifiers, Comminutors.

W. B. Field, and the Hinds County, District No. 2, gravel pit, of which he is foreman.

How to make a county gravel pit pay off

Hinds County, Mississippi, District No. 2, has saved money for the taxpayers by operating its own gravel pit, producing surface material for 300 miles of district roads.

One reason why it's successful is found in the big yellow machines that are used for the job. A Caterpillar D6 Tractor with a No. 68 Bulldozer strips overburden and maintains roads, and a Cat* D311 Engine powers the Link-Belt Speeder that loads the trucks. Both use low-cost No. 2 furnace oil for fuel, and both are serviced by the same reliable Caterpillar Dealer.

W. B. Field, pit foreman, has been on the job for 23 years. He says, "We have found Caterpillar equipment to be practically indestructible. We have never yet completely worn out one of our units."

The rugged construction and long life Mr. Field describes are matched by the operating efficiency of these machines. They're built to do *more* work, in *less* time, at *lower cost* than any competitive make. If that sounds like a strong statement, your Caterpillar Dealer can *prove* that kind of performance by a demonstration on your own job. Give him a call today.

Caterpillar Tractor Co., Peoria, Illinois.

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NAME THE DATE... YOUR DEALER WILL DEMONSTRATE

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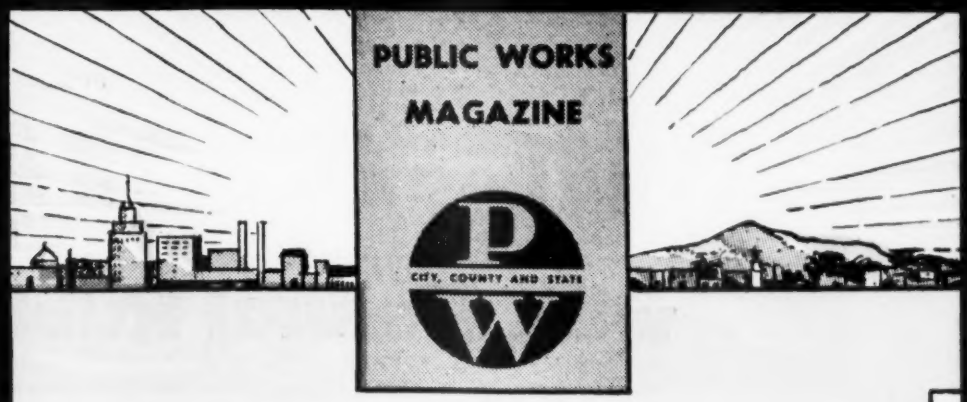


CONTENTS FOR SEPTEMBER, 1953

The 1953 volume of Public Works will be available on microfilm through University Microfilm, 313 N. First St., Ann Arbor, Mich.

THE MOST USEFUL ENGINEERING MAGAZINE FOR CITIES, COUNTIES AND STATES

THE EDITOR'S POINT OF VIEW

Engineers Ought to be Able to See Dollar Signs Too

RECENTLY a city manager illustrated the difference between engineers and administrators as follows: "Say *incinerator* to an engineer and in his mind's eye he sees a bin and a crane, a furnace, blowers, stokers, automatic charging gates and a chimney. The administrator sees the same things, but sitting on top of the chimney he sees a large dollar sign. More important, he sees the dollar sign as it stands in relation to every other dollar sign to which his community is committed."

It cannot be denied that many engineers are unable to see the forest for the trees; some defect or quirk in their training undoubtedly tends toward this. But there is no reason why it should be so. Engineers are men of ability and they can also be men of great administrative skill —if they will but step beyond the sometimes narrow limits of their technical background.

We believe that engineers have the potential to be the greatest group of professional men in the world, real leaders in national development and in the foreground of scientific progress. But if they are to take over this leadership in the near future, they will have to show more courage, more willingness to take responsibility, more initiative and more imagination. Time's a-wasting; let's go!

Is Highway Maintenance by Contract Desirable?

FROM time to time, the matter of using the contract method for highway maintenance comes up. We are not very much for it. We believe that our needed program of highway construction will take up all of the capacity of our going and established contractors, at least for quite a few years to come; and the contract system is definitely better for construction than it is for maintenance. New construction yields itself much more readily to the preparation of clear and adequate specifications, and of descriptions of the work that is to be done than does maintenance work. More important than that, we believe it is desirable for every city and every county to have a moderate fleet of good equipment for highway maintenance and betterment. Such an arrangement provides far greater flexibility in operation, and probably results in lower overall cost.

We believe that the average highway engineer or maintenance supervisor is as capable and as well qualified as the contractor is likely to be. He can do the work as well; and perhaps better because he is not interested in performing only what the specifications require and no more; he is interested in doing a good job. Moreover, he is available all of the time, and year after year. Even though a contractor should do a good job of contract maintenance for a stated period, there is no assurance that he will be available at a reasonable cost thereafter; or that someone else of equal skill, competence and honesty will be willing to bid the work thereafter at a reasonable price? All of these are factors which are of no consequence if the city or county does its own work with a continuing, well-equipped force.

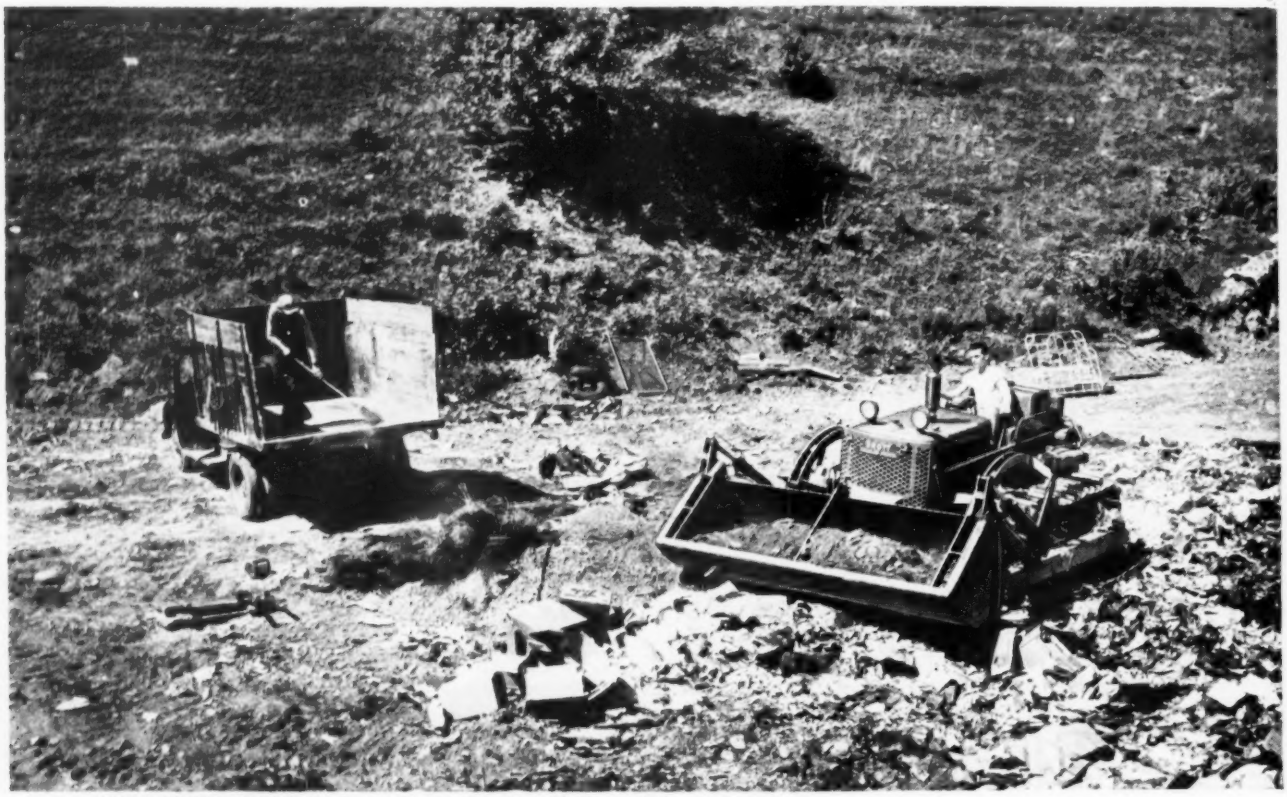
Properly Utilizing Our Engineering Skills Is Increasingly Important

PERHAPS naturally, because of the nature of his duties during the recent war, the Editor of Public Works is in frequent receipt of information concerning the inadequate employment of engineering skills by the armed forces, especially the Army and the Air Force. Engineers are in short supply and the problem, as they say, will get worse before it gets better. So we must do all that we can to meet the situation.

It is fully recognized that the armed forces have other duties than to conserve engineering skills; but this does not, by any means, preclude the employment of good sense in utilizing engineers: To use qualified engineers for jobs that require engineering skills; and not, so far as possible, to assign skilled engineers to jobs not involving engineering. To the first, there should be no exception; the nature of military duties may require exceptions to the second.

We have long felt that the armed services could greatly profit in the solution of this problem by friendly advice and help from the civilian profession. To be even moderately successful, this would require good judgment and reason on the part of both. Dull brass on the one side would have to accept some new concepts; civilian engineers on the other would have to learn and appreciate some of the problems inherent in running a military organization. It looks to us as though it is well worth trying. Perhaps some of our engineering societies will take the lead.

Lift for an Area that was



LIKE A HUGE FLATIRON, the International Crawler with its specially curved Bullclam front glides over each truckload of trash, flattening it out and compacting it to form a solid part of Oneonta's sanitary fill.

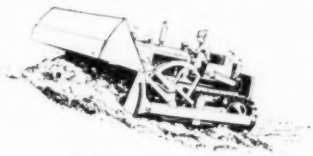
SANITARY COVER-UP. On top of each layer of garbage and trash, the Crawler-Bullclam places and packs a covering of earth . . . building valuable real estate from worthless wasteland.

PROJECT TO BE PROUD OF. Marvin Simonson of Simonson Bros., waste disposal contractors for Oneonta, New York, is proud to demonstrate the advantages of the first Sanitary Landfill in this part of the state.

Down in the Dumps

International Crawler—Drott Bullclam unit turns much criticized community dump into valuable Sanitary Landfill at Oneonta, New York

ONE MAN UNIT



1. Prepares the site

2. Crushes and compacts refuse

3. Transports and spreads earth cover

4. Grades and levels finished area

Contracting to dispose of community trash and garbage, Simonson Bros., Oneonta, faced problems they hadn't bargained for. The open dump where they burned the accumulated rubbish not only brought vigorous complaints from nearby residents but, when the wind shifted, even from townspeople three miles away.

But it's an ill wind that blows nothing but ill wind! And the odorous breeze from the community dump was no exception.

It led to community-wide approval of the Sanitary Landfill Method of waste disposal—a job for which Simonson Bros. chose an International Crawler-Drott Bullclam unit, the *only* one-man unit specifically designed to handle all four steps of the complete Sanitary Fill job.

As a result, Marvin Simonson says, "*I can't see why any city maintains an open dump when this unit makes it so easy to have a Sanitary Landfill. We had five years' experience with the burning open dump and it was five years of troubles. Now we've buried those troubles. Land values in the area have climbed back to normal, and the people who used to complain the most are our friends again.*"

The Drott Bullclam Method of Sanitary Landfill can do the same for *your* community. It can end complaints, reduce disposal costs, and create valuable building sites from worthless swamps, wastelands and gullies. See your International Industrial Distributor for details. Or write today to:

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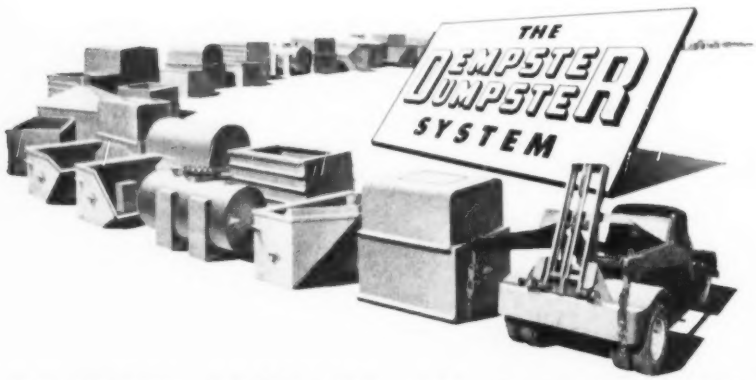
POWER THAT PAYS

Here's a One-Man Trash and Rubbish Collection System for your City

In the Dempster-Dumpster System of trash and rubbish collection only one man, the driver of the truck-mounted Dempster-Dumpster, is required for operation. The Dempster-Dumpster serves scores of detachable Dempster-Dumpster Containers located at such places as schools, hospitals, market and housing areas, hotels, grocery stores, department stores, restaurants, etc. Each container is loaded by the user. By prearranged schedule, the Dempster-Dumpster picks up, hauls to disposal area and empties each container—one after another. Entire operation is handled by hydraulic controls in truck cab, as shown above.

Container capacities range up to 4 times that of conventional dump truck bodies and each container built for trash and rubbish is completely closed—eliminating the health menace of disease carriers such as rats feeding on open and scattered refuse due to unsanitary and inadequate trash cans, barrels, crates, etc.

Without question, the Dempster-Dumpster System is the most sanitary and lowest cost method of bulk rubbish collection ever devised. Write to us for complete information. Manufactured exclusively by Dempster Brothers, Inc.

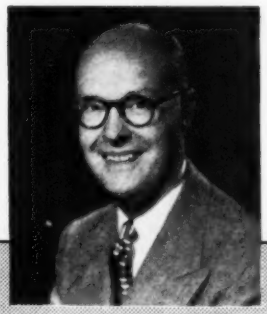


See us at Booth A-28 at Public Works Show in New Orleans, October 26-29

One Truck-Mounted Dempster-Dumpster Handles Scores of Containers . . . All Designs . . . All Sizes

DEMPSTER BROTHERS, 993 Dempster Building, Knoxville 17, Tennessee

People, Ideas and Events



BY "DOC" SYMONS

H.T.M.A. — And this is the month of September when I start perambulating here and there around the country. Unless I miss my guess, the boys from PUBLIC WORKS ("Bill" Hardenbergh, Croxton Morris, Art Akers, etc.) will also hit the convention circuit for the 1953-54 season.

★ ★ ★

I hated to have to miss the State College shindigs where the Penna. Water Works Operators and the Penna. Sew. & Ind. Was. Assn. seek knowledge and frolic come the last full week of August each year. According to the Penna. WWOA program which Secy. Rupert Kountz sent me, the usual golf and door prizes were available along with technical papers and a barbecue chicken dinner served directly from the pits.

★ ★ ★

Swedefinition — "Tact is the art of making your guests feel at home when you wish they were."

★ ★ ★

Before the AWWA Grand Rapids Convention becomes a dim memory, I want to recall a couple of things: I heard a goodly number of conventioneers complaining about the slow delivery of one section of the registration list, but if they had a sense of humor they were rewarded by the typographical errors, to wit —Ed Shiddell of Electro-rustproofing was listed as "Catholic Protection, Newtown Square, Pa." and W. Wm. Richardson was listed as "Pres., Catholic Control Corp.", while Doug Taber, B-I-F Industries Pittsburgh Manager, was listed from "Pitraburgh". (Any relation to Petrograd, Doug?)—Why don't you fellows learn to write?—Among the 75 cent words tossed off by various speakers were oligodynamic, synerisis, micelle, microstrainer, synchronous, etc.— You may not "need a program to tell the players" but if this keeps up you'll need a handy glossary to know what they're saying.

—On the way home from G. R. we played leap frog with Elon Stewart, Water Div. Engr., Syracuse, N. Y.—I bade him goodbye as he checked out of the hotel and a couple of hours later I passed him on the road. I stopped for gas and a couple of hours later I passed him on the road again; two more hours and I sat at a stop light for 20 minutes while a Swedish freighter went through the canal in Port Huron, Michigan, and just as the light turned alongside drove Elon Stewart. We both stayed that night in London, Ontario.—Next day I went on to Ithaca, N. Y., where I saw Prof. Andre Jorissen, Head of Cornell's Hydraulic Engineering. He showed me his latest arrangement for testing big Venturi meters and other hydraulic equipment. Very impressive!

★ ★ ★

Luminous Quote — "Unintelligent motion is far more important than intelligent standing still. You can't stumble on to anything if you're standing still."—Kettering

★ ★ ★

Third Generation — And Purely Personal—Our son, Jimmy, who is known to a number of my readers, has spent the past summer working for George Straub, Supt., and Stanley Longhurst, Asst. Supt., Westchester Joint Water Works No. 1. If he's going into this sanitary engineering business, there's no better place to start than in a water plant working for a couple of capable engineers. Jimmy returned this fall to Cornell University for his fifth year of Civil Engineering.—Seems like yesterday he was taking pictures with me at the AWWA meeting in Atlantic City in '48.

(*Continued on page* 131)

UP FRONT FOR ADEQUATE ROADS

BY
LEO J. RITTER, JR.
New York University

Jersey Turnpike — The New Jersey Turnpike Authority, in a recent report to bondholders, has announced that average daily traffic on the toll road has hit levels predicted for 1971. In recent months traffic has averaged 76,700 vehicles per day. Stricter policing and new safety measures have sharply reduced the accident rate on the Turnpike; the accident rate for the first six months of 1953 was 60.1 per 100 million miles of travel. This can be compared with the rate of 380 accidents per 100 million miles of travel on New Jersey's public highways in 1952.

A Pleasant Visit — Had the opportunity recently to spend a few hours in the offices of the Port of New York Authority, which has the responsibility for design and operation of some of the nation's outstanding urban highway facilities, including the George Washington Bridge and the Holland and Lincoln Tunnels, all of which connect New Jersey and Manhattan. These are among the most heavily traveled routes in the country. Enjoyed a very pleasant chat with Ed Wetzel, Assistant Chief of Planning, about present and future activities of the agency. Mr. Wetzel is one of the outstanding traffic engineers in the United States, with a background of more than 20 years of experience which began in Indiana at the time of the inauguration of the state-wide planning surveys. Many foreign engineers and planners visit his office every year to observe for themselves the latest techniques in handling urban traffic problems. When all is said and done, though, I still think that the traffic engineer is one who has an impossible job. The better job he does the more cars are attracted to the improved facility, which in turn makes more congestion, and pretty soon the traffic engineer is right back where he started. It must be lots of fun trying, though. Also spent some time with Marty Kapp, Chief Soils Engineer of the Authority, looking at their fine laboratory facilities and talking about the soil problems connected with their tremendous expansion program at Newark Airport. Practically all big airports have soil problems these days, since it seems that the only places near cities which are large enough for modern airports are on land which isn't suitable for anything else and not really suitable for an airport, either. Also looked at the helioport on top of the Port Authority Building in downtown Manhattan, but didn't succeed in getting a ride.

Sand Lift — A basic idea which can not be repeated too often and which is of great practical importance is set forth in an article in a recent issue of *The Co-Operator*, published by the LeTourneau-Westinghouse Co. of Peoria. The article is by W. H. Taylor, Highway Commissioner of Chippewa County, Wisconsin. He tells of the construction of county roads using a 6-inch lift of clean sand, a 6-inch lift of crushed gravel above the sand, and a 2-inch "blacktop mat". Why the sand lift? To eliminate the effects of frost action by providing a base composed of free-draining, non-frost-susceptible material. Another advantage is that the road surface is built up above the general contour of the surrounding land, which permits wind to sweep the snow off the surface as it falls, thus reducing snow removal operations to a minimum.

Just Musing — Since we are not having a vacation this year, at least not a "traveling" one, we fell to thinking the other day about the beautiful roads we had seen, both in this country and abroad. What do you think is the most beautiful road in America? Here are some we

(Continued on page 130)

SPECIFY RODNEY HUNT

FOR SLUICE GATES

Standard Sizes: 6" to 108" diameter

Larger Rectangular Sizes for Special Installations

Illustrated are three 72" x 96" bronze-mounted sluice gates: part of a 300,000-pound shipment to the U.S. Corps of Engineers for high-head use. This is only one of 2000 sluice gate combinations that can be ordered directly from the Rodney Hunt catalog! With new equipment and enlarged facilities we can bid competitively with firm delivery on a wide range of gates. Modern foundry practice and precision finishing make Rodney Hunt sluice gates an important, low-maintenance asset to any water control project.

Free! 232-page color catalog

This is one of the most complete works in the field. It contains photographs, drawings, specifications and complete descriptions of our sluice gates, timber gates, hoists, valves, racks and rakes, plus a valuable 28-page section of engineering data on hydraulic problems.

This important catalog was specially prepared and edited for consulting engineers, contractors and other executives who are *actively* engaged in the water control field. Please write on your letterhead for Catalog WCA-952, Rodney Hunt Machine Co., 82 Lake St., Orange, Mass., U.S.A.

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Water Control Apparatus Division

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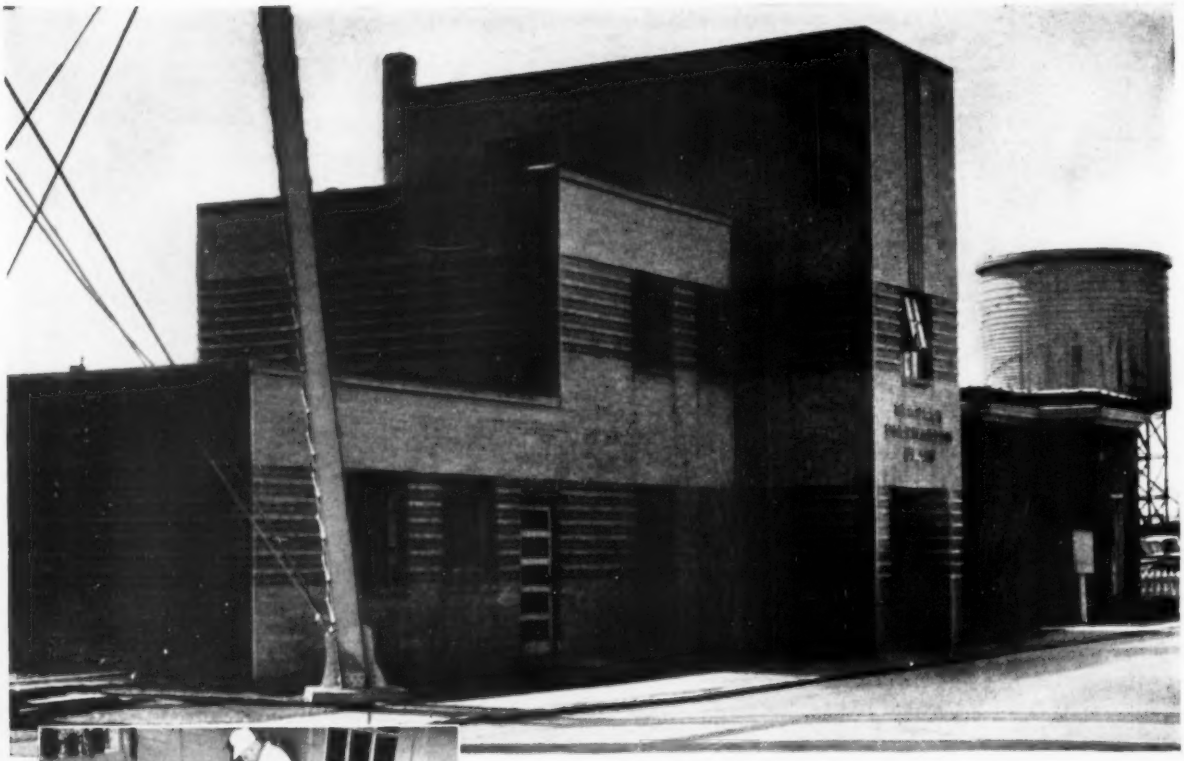

Staples' compact Permutit Precipitator has 400 gpm capacity. Softens hard well water, removes turbidity, iron, and manganese.

Two 8' x 9' Permutit Gravity Filters remove last traces of suspended matter, deliver a crystal-clear, softened water.

How *Staples, Minnesota gets soft, clear water*

Staples' well-water supply caused plenty of trouble . . . total hardness 275 ppm, alkalinity 200 ppm, iron 3 ppm, turbidity 30 ppm. To solve these problems, Staples turned to Water Conditioning Headquarters.

Now Mr. E. H. Klang, Supt. of the Water and Light Dept., reports the Permutit-treated water "very fine in all respects—very clear."

Permutit recommended the equipment shown at left, plus a carbonation tank. Turbidity is reduced to only 3 ppm . . . iron to 0.1 ppm. Hardness and alkalinity are reduced to specified requirements. Because of high Precipitator efficiency, each filter is backwashed only once a week for 20 minutes.

"The Precipitator has not given any trouble. The Permutit filter is one of the best . . . has been trouble-free," adds Mr. Klang about the Permutit equipment installed in 1939.

Free Technical Bulletins

Write today for full information on any water conditioning process or problem. The Permutit Company, Dept. P.W. 9, 330 West 42nd Street, New York 36, N. Y.

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Economical...Factory-compounded in fast colors... Red, Black or Green. Long-Lasting...Easy to apply

Walk-Top gives a proved, uniform, protective, wear-resistant seal for all types of pavements.

In all parts of the country Paving Contractors and "Hot Plant" operators are now using Walk-Top to satisfy the demand for a smooth, colorful surface that is grit-free, resilient, and weather-proof. They have found that this easy-to-use material—applied cold—offers an economical method of sealing all surfaced areas.

This photograph shows the green walks on Bedloe's Island around the Statue of Liberty

Home-owners are proud of their distinctive "Walk-Top-sealed" driveways

FOR PLAY AREAS

Walk-Top seal is *standard* for thousands of school play areas throughout the country. In San Francisco, for example, over 2,000,000 sq. ft. of school playgrounds, both old and new, have been sealed with Walk-Top in the last two years alone. Other typical applications may be found in Akron, Pittsburgh, Washington, D. C., Providence, Fresno and Cincinnati. School and Park Authorities in these cities and in many others repeatedly specify Walk-Top.

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Walk-Top is used extensively on all types of paving to provide a fast-draining, void-filling seal that is colorful, smooth and resilient.

FOR DRIVEWAYS

Walk-Top, easily applied cold over the old pavement, by brush or squeegee, gives a clean, enduring, colorful seal—at low cost.

WALK-TOP is available through Dealers and Contractor-Distributors throughout the country. Contact our nearest office for information.

WALK-TOP and Play-Yard Binder for Playgrounds—Laykold Wearcoat and Resurfacer for Tennis Courts—standards of quality for over *twenty* years.

**For oil-resistance ask for Colfix Jet Seal.*

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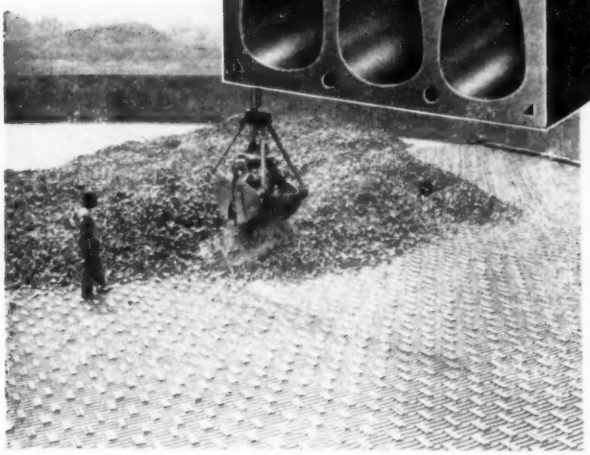
NATCO SALT GLAZED UNIFILTER BLOCKS

for Trickling Filter Beds of Sewage Disposal Plants give GREATEST EFFICIENCY and ECONOMY

Aerial view of Sewage Treatment Plant in Worcester, Mass., eight beds in all, each 176' 0" diameter. Natco Unifilter Tile used for trickling filter beds in first unit.

Engineers: Hayden, Harding & Buchanan, Boston

Contractors: V. V. Barletta & Sons, Roslindale, Mass.



Close-up view of filter bed showing filter media directly on top of Unifilter Block Underdrain Floor at Sewage Treatment Plant in Worcester, Mass.

Natco Salt Glazed Unifilter Blocks—strong, rugged, corrosion resistant, permanent in character and form—have been used with outstanding success in some of the largest sewage disposal plants in the world. Natco Unifilter Blocks are convenient and easy to handle and lay. They combine maximum capacity in drainage and aeration, and insure lowest future maintenance and repair costs.

Send this coupon for a copy of the complete Natco Unifilter story with filter design details and data.

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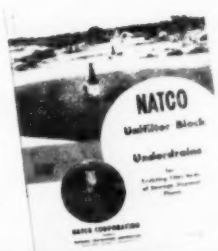

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General Offices: 327 Fifth Ave., Pittsburgh 22, Pa.

Please send me a copy of Bulletin UF-3, giving full information on NATCO Unifilter Blocks and details on trickling filter design.

Name _____

Company Name _____

Street _____

City _____ Zone _____ State _____

BOOKS IN BRIEF

PHOENIX, ARIZONA, 2½ YEARS REPORT

This report covers the 2½ years up to July 1, 1952, and tells in an interesting way what has been done, how it was accomplished and what is planned for the future. It is excellently illustrated with photographs and drawings showing the citizens where their money has gone. An excellent job; our congratulations.

THE TRAVERSE METHOD

This book, in German, presents a completely new analysis procedure for continuous structures. It is applicable to all structures composed of straight members rigidly connected at the joints, and to those subject to sidesway or restrained laterally. It is statically and mathematically exact in its use of the elastic theory. The procedure was developed by Ralph W. Stewart, chief engineer of bridge design of the City of Los Angeles. More information about the book and the method can be obtained from Mr. Stewart, 1200 Arapahoe St., Los Angeles 6, Calif.

BRITISH ROAD RESEARCH 1952 BOOKLET

This is the annual report of the British Department of Scientific and Industrial Research. The subject matter is broken up into sections under the main headings of Safety, Traffic, Materials and Methods of Construction. The booklet gives the present status of the experimental work under way by this governmental research organization. Copies may be obtained from the Sales Section, British Information Services, 30 Rockefeller Plaza, New York 20, N. Y., at a cost of $1.15.

HIGHER SURVEYING

The 7th edition of this fine book has just been published. Revisions include new data on barometric leveling; fuller and up-to-date information on photogrammetric surveying and aerial photogrammetry has been added. Many other revisions have been made to make the text fully modern and easier to use. 667 pages. Breed & Hosmer; published by John Wiley & Sons, Inc., New York. $7.

Specialty Board for Sanitary Engineers Recommended

Use of the facilities of the American Society of Civil Engineers and the Engineers' Joint Council to obtain desired certification of sanitary engineers has been recommended by the Joint Committee for Advancement of Sanitary Engineering, a grouping of representatives of five major organizations in the field. After detailed study of numerous proposals for enchancing the recognition of sanitary engineers, action was taken, during a July 27-28 meeting of the committee in Washington, recommending steps to be taken in establishment of a Specialty Board.

As proposed, a certification board of five members will be appointed by the Board of Direction of ASCE. Ultimately, both the joint committee and the specialty board are proposed to become administrative functions of Engineers Joint Council, because of the cooperative interest of several professional organizations in the program. Functions of the board members will be augmented by appointed consultants.

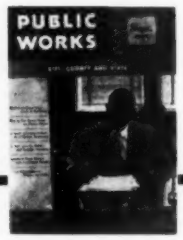
Upon application by individuals and satisfactory evidence of professional ability in the field of sanitary engineering, certificates will be issued. Those so certified will be designated members of an American Academy of Sanitary Engineers. The sole purpose proposed for the academy is recognition of those certified by the specialty board. Expense for operation of the board, issuing of certificates and maintenance of a roster will be defrayed by collection of a fee for certification.

Before this proposal can become a reality, endorsement of the ASCE Sanitary Engineering Division and approval by the ASCE Board of Direction are needed. Before EJC can administer the program, adoption of the proposal by that Council is required.

Represented on the joint committee which produced this proposal are: American Public Health Association, American Society of Civil Engineers, American Society for Engineering Education, American Water Works Association, and Federation of Sewage and Industrial Wastes Association.

As a definition of sanitary engineering, the joint committee adopted the statement prepared by the committee on Sanitary Engineering of the National Research Committee in October, 1943.

(See group picture on p. 154)



LEADERS IN THE PUBLIC WORKS FIELD

Blucher A. Poole (see the front cover of this issue) is Director of the Bureau of Environmental Sanitation, Indiana State Board of Health, and Secretary of the Indiana Stream Pollution Control Board. He has been with the State since graduation from Purdue in 1931 except for military duty in World War II. He directs all the activities of the State Board of Health in sanitary engineering, dairy products, food and drugs, weights and measures, and water pollution abatement activities which have received national recognition.

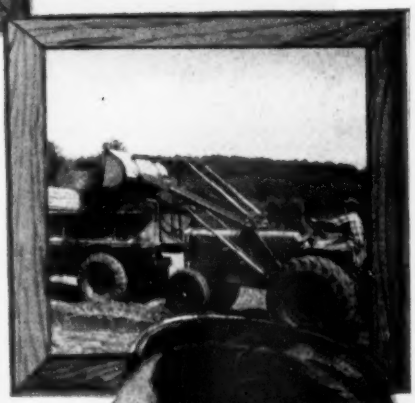
He is a member of AWWA (past chm., Ind. Sec., past director and Fuller awardee); FSIWA (past pres., CSSWA, and past dir.); APHA; ASCE (past chm., Ind. Sec., and incoming chm., Exec. Comm. of Sanitary Eng. Div.); and CSSE (past chm.). He is a member of the Executive Committees of the Ohio River Valley Water Sanitation Commission and the Indiana Flood Control and Water Resources Commission.

Approximately one-half of his military career was spent in the Sanitary Corps where he exhibited unusual skill and ability. He rose to the grade of Major, serving as sanitary engineer, Office of Surgeon, Hq., 6th Service Command. In 1944 he became Chief of the Water and Sewage Section, Repairs and Utilities, Office of Chief of Engineers, and received the Army Commendation Ribbon for this service. He is a Lt. Col., Engineer Reserve.

He was married in 1933 to Marian Crane of Lebanon, Indiana. They have two boys—Dick and Jim. His hobbies are quail hunting and fishing; and he and Marian play a right smart game of bridge.

DISCHARGE IS FAST OR SLOW,
depending on how you want it. Hydraulic controls make this possible. Mid-section pivot of loader arms give longer reach in dumping position.

STRIPPING TOP SOIL
is another job this versatile unit does well. The simple rugged design of the Ware loader correctly distributes weight on tractor frame, regardless of the operation being performed. Down-pressure can be applied when it is necessary in tough digging. Hydraulic rams absorb shock loads . . . mean longer life and lower maintenance for both tractor and loader.



HYDRAULICALLY CONTROLLED BUCKET
assures greater "breaking-out" action—full bucket loads every time. 28° roll back helps prevent wasteful spillage.

Picture Your Profits...

with this

OLIVER HYDRAULIC Tractor-Loader

An Oliver Industrial Wheel Tractor with this *all-hydraulic* front-end loader is a combination that's hard to beat for low-cost, profitable operation. With any Oliver Wheel Tractor, you get famous Oliver *dependable* plus power, easy maneuverability, rugged construction. With the loader, manufactured exclusively for Oliver Wheel Tractors by Ware Machine Works, you get completely hydraulic operation which means easier, surer control for more efficient digging and loading.

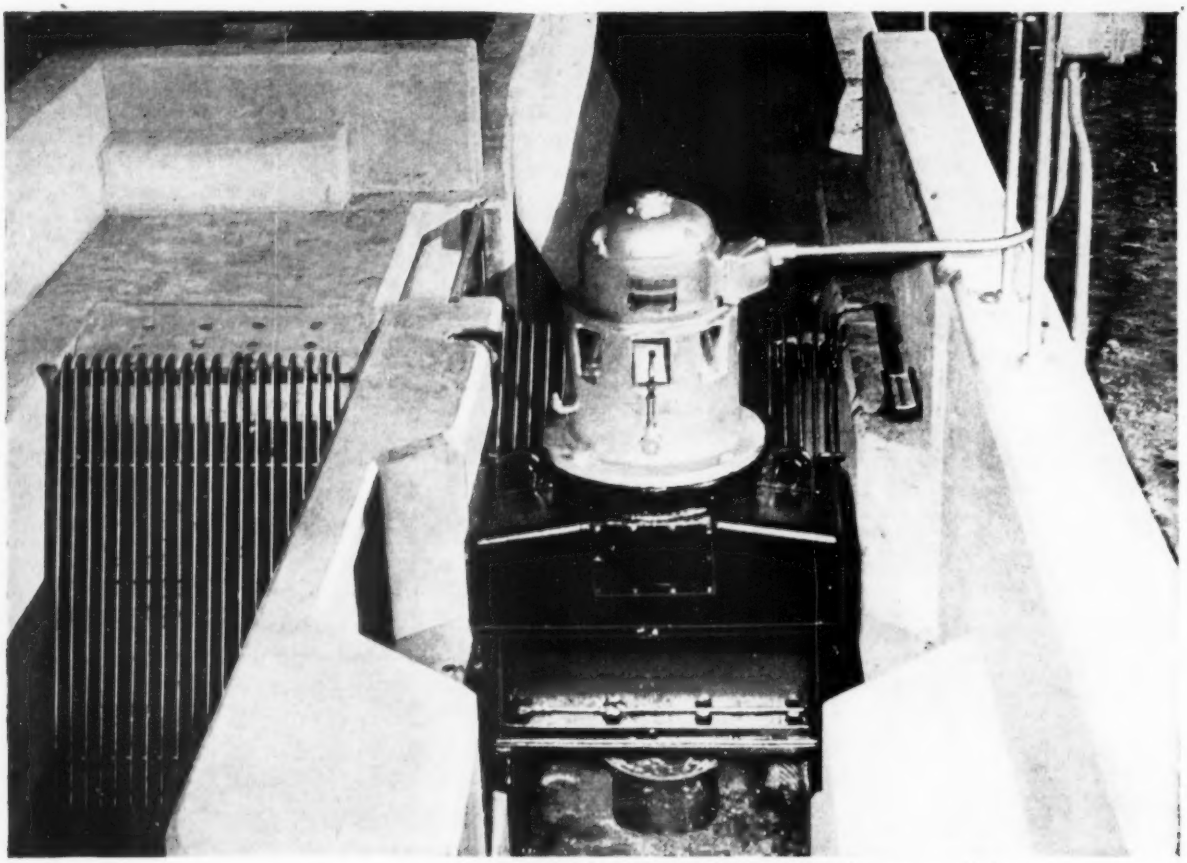
Take a look at the "profit pictures" shown here. They'll convince you that it's well worthwhile to ask your Oliver Industrial Distributor to arrange a demonstration of an Oliver tractor-loader combination for you.

THE OLIVER CORPORATION

400 West Madison Street, Chicago 6, Illinois

A complete line of industrial wheel and crawler tractors

Get full details of this month's products . . . mail your Readers' Service card today.



COMMINUTORS ARE READILY INSTALLED in new or existing rectangular straight-through flow sewage channels. They may be used either as single units shown above or multiple units, depending on your needs.

Worthington comminutors eliminate costly handling of sewage solids

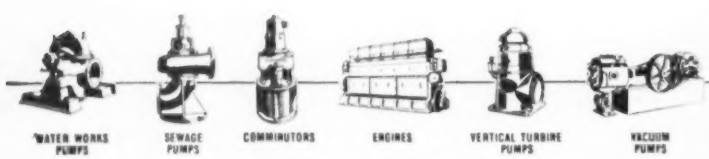
With a Worthington comminutor operating continuously, you can forget about raking, hauling, grinding, and burial or incineration of coarse solids. Here's why:

Worthington comminutors *automatically* cut coarse solids in raw sewage so rapidly that loss of head is minimized. Peak loads in excess of comminutor capacity are easily handled by a baffle screen. The addition of a mercury seal keeps all working parts watertight for continuous operation even when comminutor itself is submerged.

Quick, simple installation in either new or existing rectangular sewage channels, indoors or outside, keeps costs to a minimum. Stainless steel screens and cutters are easy to remove for inspection, adjustment, sharpening or replacement.

Worthington engineers will be glad to help you mechanize and modernize this or any other phase of your sewage treatment. Write for full details on Worthington's complete line of sewage disposal equipment. Worthington Corporation, Public Works Division, Section W.3.3, Harrison, N. J.

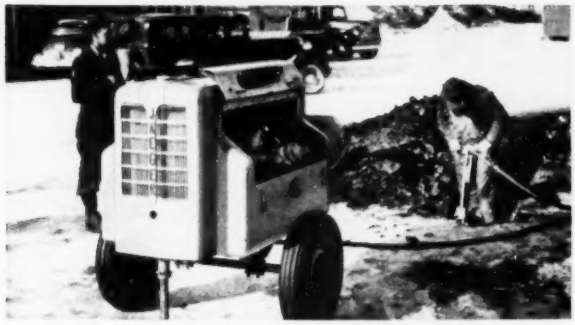
W.3.3



All Major Public Works Equipment Under One Responsibility

WORTHINGTON

Public Works Equipment

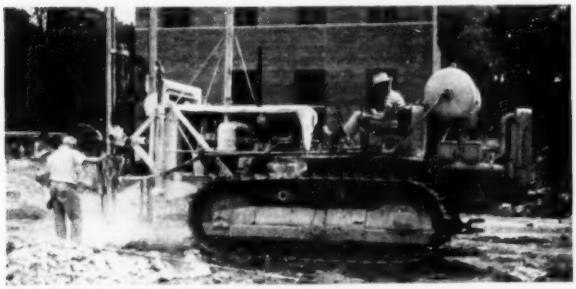


75 cfm puts full wallop in a heavy duty breaker.

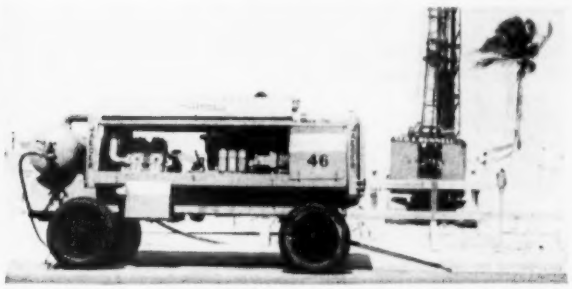
With 125 cfm these tools do 30% 40% more work.

Three 365's — enough capacity for 4 heavy wagon drills.

More Jaeger air speeds many jobs, such as line testing.



Tractor mounted and powered, operates two big drills.



Ample air for heavy pile hammers, with a Jaeger 600.

Only JAEGER has built thousands of air compressors in "new standard" ratings...

75 • 125 • 185 • 250 • 365 • 600 cfm

Any compressor that produces 15% to 25% more air than others, without racing, overheating or vibration, must be engineered to higher standards.

Jaeger, alone, has engineered these new standards into thousands of compressor units, whose design features are not found in any other line of portable compressors, *old or new*:

- Balanced 2-stage "W" type compressor in every model from 75 to 600 ft.
- 75% to 100% larger valves; larger intercoolers and air receivers.
- Positive force feed lubrication, standard.
- Relief valve for automatic drainage, standard.
- Automatic "Fuel Miser" standard on all models where speed control means worthwhile fuel saving.
- Bigger clutches than any other compressors; bigger engines operating at conservative speeds.

Ask Your Jaeger Distributor to Prove This: At prices actually less than those still asked for "old standard" compressors, Jaeger compressors provide 15% to 25% greater volume of air at the lowest known cost per cubic foot.

THE JAEGER MACHINE COMPANY

400 Dublin Avenue, Columbus 16, Ohio

Pumps • Concrete Mixers • Truck Mixers • Aggregate Spreaders • Concrete Spreaders and Finishers

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FREE EQUIPMENT DATA to Help Your PUBLIC WORKS PROGRAM

The engineering information in these helpful catalogs will aid you in your Engineering and Public Works programs. Just circle numbers you want on the coupon, sign and mail. This free Readers' Service is restricted to those actively engaged in the public works field.

NEW LISTINGS

Keep Batteries in Peak Condition

337. No more battery troubles on slow-moving trucks and other equipment that fail to keep up the charge with conventional DC generators. The Leece-Neville AC-DC generating system is easy to install, needs minimum maintenance and supplies all the power you need. Get full details by checking the coupon. Leece-Neville Co., 5109 Hamilton St., Cleveland, Ohio.

Self Loader For Your Dump Truck

338. Find out how your dump truck can be converted to a complete loading, hauling and dumping unit by the addition of a Brisson "Lodal". Illustrated bulletin shows many applications on refuse collection, snow removal, excavation and materials handling, all done by one man operating simple hydraulic control. For your copy write to Lodal, Inc., Norway, Mich., or check the handy coupon.

Get Greater Efficiency on Garbage and Refuse Pick-Up

340. Reduced pick-up costs for garbage and refuse collection are claimed with use of the Quad-O-Matic Loader. High-capacity body carries big loads and reduces number of trips to disposal point. Four loading buckets operate independently and distribute load evenly. Hydraulic controls. For more details get bulletin by checking coupon. Equipment Mfg. Co., Dept. PW, 21550 Hoover Rd., Detroit 5, Mich.

Be Sure to Investigate Two-Piece Filter Floor Construction

341. Advantages claimed for trickling filter floors constructed of IMCO Two-Unit blocks include: greater mechanical strength; maximum aeration efficiency; smooth flow line in drainage channels; and construction simplicity. Full information on this long-tested floor system is available from Industrial Materials Co., Somerset St. & Trenton Ave., Philadelphia 34, Pa., or by checking the handy coupon.

Controller Maintains Water Level In Treatment Basins

348. Instrumentation which maintains liquid level in sedimentation basins, and thus controls level in succeeding treatment basins, is described in Application Engineering Data Sheet No. 831-20, issued by The Foxboro Co., Foxboro, Mass. All components are described in the illustrated data sheet. Get your copy by checking the coupon.

Design Data on Clarification for Water, Sewage and Wastes

339. In Bulletin No. 117, Process Engineers present 32 pages of design data and engineering drawings of circular clarifier mechanisms for all sizes of installations; the Oxidator; Reactor-Clarifiers, and the Pressure Flotation System. Flow sheets and information on related apparatus are included. Check the coupon for your copy. Process Engineers Inc., 6381 Hollywood Blvd., Los Angeles 28, Calif.

An Introduction to Flowrator Meters

344. The theory of operation of the Flowrator meter, special characteristics, and advantages of this type of flow rate measurement for liquids and gases are clearly described in an illustrated 16-page booklet available from Fischer & Porter Co., Hatboro, Pa. Get your copy by checking the coupon today.

Job Data Offered on New Steel Water Mains

342. A 16-page illustrated report listing construction details on steel water lines is entitled "Dresser Coupled Steel Water Lines in the Year 1952." Get your copy from Dresser Mfg. Div., 59 Fisher Ave., Bradford, Pa. by checking the coupon.

Protective Coatings For Use at Sewage Plants

343. "Horntrol", a tough black protective coating said to be specifically formulated to resist corrosives at sewage treatment plants is described in a new 4-page booklet. Get your copy from A. C. Horn Co., Inc., 10th St. and 44th Ave., Long Island City 1, N. Y., or check the coupon.

All About Zeolite Softening

345. A new 12-page bulletin, No. WC-108, which gives details on the design and operation of zeolite softeners, explains the sodium and hydrogen cycles, describes types of zeolites and furnishes engineering data for determining the size of softeners has been published by Graver Water Conditioning Co., 216 West 14th St., New York 11, N. Y. You can get a copy by checking the coupon.

"How To Do It" With a Road Widener

346. A new "how to do it" folder on the Domor Road Widener, a quick change attachment mounted on any motor grader blade, has been released by Ulrich Products Corp., Roanoke, Ill. Well illustrated with step-by-step photographs, it explains the proper use of the road widener in preparing the widening trench along the edge of a surfaced road. Check the coupon today.

Carter Equipment for Water, Sewage and Waste Treatment

347. All principal types of Carter equipment for treatment of water, sewage and industrial wastes are briefly described and illustrated in new Bulletin No. 5303, issued by Ralph B. Carter Co., Hackensack, N. J. All engineers should get this handy reference. Just check the coupon.

Grinders and Shredders For Sewage Treatment Plants

349. Gruendler screenings shredders may be connected with bar screens at either new or existing plants to reduce operating expense and simplify disposal problems. For full descriptions of screenings shredders and dry sludge shredders check the coupon or write Gruendler Crusher & Pulverizer Co., 2915 N. Market St., St. Louis 6, Mo.

Have You Heard About Bionetics For Sewage Treatment?

350. Bionetics, a dry staple powder of groups of living organisms preserved with enzyme systems, is available in several types to improve and accelerate the biological processes performed at sewage treatement plants. Get full data from Reliance Chemicals Corp., Box 6724, Houston 5, Texas. Just check the handy coupon.

9-53

USE THIS COUPON to get detailed information on products and materials mentioned in this issue. Circle numbers below and mail today.

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231 232 235 241 246 247 249 252 258 264 273
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New Products, pages 147 to 153:

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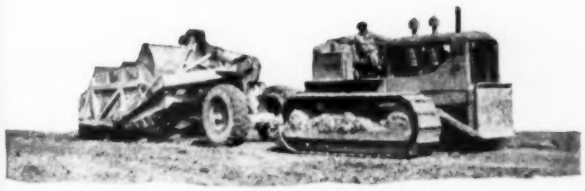
PACAL BLADES

cut costs at the point of Power

All of today's higher earthmoving horsepower is concentrated on the cutting edge. Here only the hardest, toughest steel can give true economy. Only Pacal Blades have kept pace with increased horsepower by their proven shock and abrasion resisting qualities. Pacal Blades are the best buy for all machines whether the job seems light or involves heavy dirt, ores and aggregates.

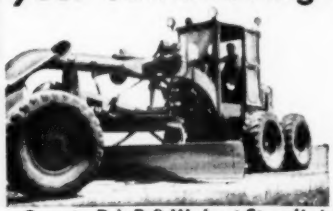


USE PACAL BLADES on all your earthmoving equipment

Use Pacal Heat Treated Plow Bolts on all your Pacal Blades. They're twice as strong—do not stretch or loosen.

Only Pacal Plow Bolts and Pacal Blades have kept pace with the increased horse power of today's earthmoving machines.

Write or call Dept. BD-93



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Thousands use our Readers' Service card to keep up to date . . . do you?

To order these helpful booklets check the coupons on page 32.

NEW LISTINGS (Cont.)

Get Latest Data on Refuse Collection Bodies

351. "Pak-Mor" garbage collection unit packs almost 45 cu. yd. of loose garbage into its 15 cu. yd. body, and discharges in less than 30 seconds by pushing it out. The company makes a 12 cu. yd. unit also. Can be mounted on any 1½ or 2-ton C.O.E. or conventional type truck chassis. Check coupon for data. Pak-Mor Mfg. Co., San Antonio, Texas.

Design Data for Trickling Filter Underdrains

352. Full details and engineering data on Natco Unifilter blocks for trickling filter underdrains are offered in a 16-page booklet available from the Natco Corp., 327 Fifth Ave., Pittsburgh 22, Pa. Specifications, construction details and design data are included. Use the coupon today to get your copy.

●

BUSINESS AND ADMINISTRATION

Two-Way Radio Equipment For All Departments

293. The benefits of two-way radio communication in the uncongested non-interference 450-megacycle range make full information on this subject important to all engineers. Get full data on trouble-free systems from Motorola, Inc., Dept. PW, 4545 Augusta Blvd., Chicago 51, Ill. Just check the coupon.

Excellent Booklet Shows Aerial Mapping Technique

311. A clear explanation of the technique of aerial topographic map production is given in "Focusing on Facts". Striking photographs trace aerial photographs to final maps for highway planning, detailed city photomaps, reservoir surveys and many other applications. An excellent guide for public works and planning officials. Use coupon or write Fairchild Aerial Surveys, Inc., 224 E. 11th St., Los Angeles 15, Calif.

The Workings of Two-Way Radio Systems

328. Engineers who use two-way radio to direct snow removal operations say this type of communication is essential for efficiency in their work. To learn the basic systems in use, what they will do, and how RCA engineers will assist you in your plans, get Form 2J8055 from Mobile Communications section, RCA, Camden, N. J. Just check the coupon.

Easy-Reading Bulletins Explain Surveying Instruments

329. A series of instructional bulletins which explain the inner workings of surveying instruments have been issued by David White Co., 315 W. Court St., Milwaukee 12, Wis. Written in question and answer form, they make interesting reading for the beginner and experienced surveyor alike. Get your copies by checking the coupon.

●

REFUSE COLLECTION AND DISPOSAL

Quel—For Control Of Garbage Odors

27. A new product, Quel, is offered to stop odors from garbage and waste. A small quantity of this liquid is said to sanitize garbage containers, kill maggots, repel flies and other pests. Get full details from W. B. Farrell, Inc., 1960 Opdyke Rd., Pontiac, Mich. Check the coupon.

Increasing the Efficiency of Bulk Rubbish Collection

177. Strategically spotted bulk containers can be handled by one man operating a Dempster-Dumpster equipped truck. Get full details of this cost-saving system of rubbish collection, as used by many cities to increase efficiency and eliminate unsanitary conditions. Write Dempster Brothers, Inc., 952 Dempster Bldg., Knoxville 17, Tenn., or use the handy coupon.

What You Should Know About Refuse Incinerators

58. Two helpful bulletins tell what you should know about low cost refuse incineration for the small community and for larger cities. Your questions on mechanical stoking, burning rates and operating problems are discussed. Get Bulletins 217 and 223 from Nichols Engineering & Research Corp., 70 Pine St., New York 5, N. Y. Just check the coupon.

How to Reduce Refuse Collection Costs

123. The sequence of operations for fast loading and refuse compaction in the Gar Wood Load-Packer are illustrated and described in 12-page folder W-110, together with size data and details of hydraulic elements. Be sure to check all details of the efficient Load-Packer system. Check coupon or write Gar Wood Industries, Wayne Division, Wayne, Mich.

Efficient Material Handling to Reduce Incineration Costs

130. Blaw-Knox Buckets specially designed for refuse and garbage handling are described in 22-page Bulletin 2350. Illustrations show progress of material through a modern municipal incinerator plant. Dimensions and incinerator bucket specifications are included. Blaw-Knox Div., 2124 Farmers Bank Bldg., Pittsburgh 22, Pa.

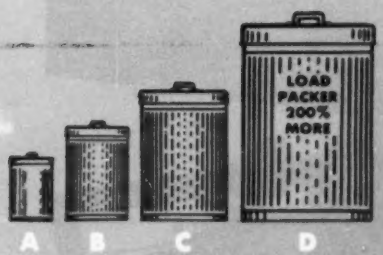
Thinking of Sanitary Landfills? Get This Booklet Now

131. One of the most informative descriptions of the sanitary landfill method of garbage and refuse disposal is presented in Caterpillar's 16-page booklet "A Look to the Future with Sanitary Landfill." The booklet is designed to serve as a guide to proper site selections, the choice of the right equipment to do the job, and the actual operations of sanitary fill. Pictorial treatment shows how and when to start such a program, what to look for in a site, benefits received by the community, and other important considerations. Published by the Caterpillar Tractor Co., Peoria 8, Ill. Check the coupon for your copy.

ANOTHER GarWood ECONOMY FEATURE

SQUEEZE

REFUSE COLLECTION BUDGETS WITH LOAD-PACKER'S DOUBLE COMPACTION



WHAT COMPACTION MEANS—

- **A** Closed body but no compaction.
- **B** Closed compaction body but no load retention.
- **C** Closed compaction body with average retention.
- **D** LOAD-PACKER body with maximum, double-acting compaction plus positive load retention.

Another big reason for Load-Packer's greater economy is the double compaction of hydraulic ram and automatic retaining panel. Twin, heavy-duty hydraulic cylinders exert up to 70,000 pounds of pressure on ram to compress refuse into a solid mass. Automatic, hydraulic retaining panel scrapes ram clean, helps ram compact, then retains compacted load under pressure in body. Double compaction of ram and retaining panel, plus positive retention under pressure, adds up to 200% extra capacity per cubic content of body.

Increased load capacity means fewer time-consuming trips to disposal point. Crew covers a larger area between disposal trips thus collecting more refuse per day. Crew idle time is minimized, collection schedules are speeded and expenditures for fuel, oil, tires and maintenance are substantially reduced.

You can step up your refuse collection schedules and reduce your operating costs by putting Gar Wood LOAD-PACKERS to work in your community. Mail the coupon below, *NOW!*

CHECK THESE EXTRA FEATURES:

- Larger-capacity tapered body
- Lower, wider loading hopper
- Fully-automatic finger-tip control
- Streamlined leakproof design
- Improved hydraulic dumping

Gar Wood Industries, Inc.
3001 Main St., Wayne, Michigan
Att'n: Customer Service Dept. 21105

Please send me facts about cutting refuse collection costs with the new, 1953 Gar Wood LOAD-PACKER.

Name _____

Position _____

Address _____

City _____ Zone ___ State ___

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GAR WOOD INDUSTRIES, INC.

WAYNE, MICHIGAN

TRUCK EQUIPMENT: Dump Truck Bodies and Hoists, Winches and Cranes, Refuse Collection Bodies, Elevating End-Gates. **CONSTRUCTION EQUIPMENT:** Excavators, Scrapers, Dozers, Ditchers, Spreaders, Finegraders, Truck-Mounted Road Graders.

To order these helpful booklets check the coupon on page 32.

Sanitary Landfill Operation and Methods

28. The location and area requirements for sanitary landfill, operation methods for trench type and area fills, equipment selection and costs are items discussed in an 8-page booklet issued by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. Be sure you have this reference when considering the problem of garbage and refuse disposal. Check the handy coupon today.

●

SEWERAGE AND WASTE TREATMENT

What You Should Know About Trickling Filter Underdrains

20. Specifications for vitrified clay underdrain blocks conforming to ASTM standards, suggestions for layout and construction of trickling filter floors, dimensions of standard blocks, channel covers, angles and other fittings are available from the Trickling Filter Floor Institute, c/o Editor, Public Works, 310 E. 45th St., New York 17, N. Y. Check the coupon and we will forward your request.

Valuable Booklet on Porous Diffuser Plates and Tubes

21. A helpful 20-page booklet published by the Norton Co. is a complete guide for the selection of porous media for installation in activated sludge plants. Full data for the designing engineer is provided by careful detailing of physical characteristics of plates and tubes. Maintenance of porous media also is discussed at some length. For your copy of Form 1246 write the Norton Co., Dept. PW, Worcester 6, Mass., or use the coupon.

How Cities Clean Sewer Lines From Street in One Operation

25. In a helpful 28-page handbook of sewer cleaning methods and equipment the makers of OK Champion sewer cleaners give full details of power and hand operated models. Also included are data on expansion buckets that take dirt from sewer to street in one operation, root cutters and other accessories. Get your copy by checking coupon. Champion Corp., 4752 Sheffield Ave., Hammond, Ind.

How to Make Better Sewer Pipe Joints

37. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston Co., Dept. P.W., Adams, Mass.

A Handbook of Sewer Cleaning Methods and Materials

44. Complete, easy-to-follow directions for every type of sewer cleaning operations and the equipment needed for effective cleaning work is covered in a 40-page booklet issued by Flexible Sewer-Rod Equipment Co., 9059 Venice Blvd., Los Angeles 34, Calif. Full details are provided on power cleaning machines, the SeweRodeR, hand tools and all accessories. Water main and culvert cleaning methods are included. Check the coupon for your copy of this helpful handbook.

Helpful Design Data For Sewage Ejectors

81. The applications and advantages of pneumatic sewage ejectors are outlined in a new bulletin of the Blackburn Smith Mfg. Co., Inc., Hoboken, N. J. Included are piping diagrams for electrode and float switch controls plus dimensions and layouts for single and duplex systems. Get your copy by checking coupon.

Theory of Controlled Digestion With Floating Cover Tanks

88. In an excellent 40-page booklet, an authoritative discussion of digestion theory and practices, including design, operation and economics is presented by the Pacific Flush Tank Co., Chicago 13, Ill. Complete data are given on the use of floating covers, together with details on tank construction, piping and control chambers. Requests for this valuable booklet must be made on business letterhead.

What You Should Know About Design and Use of Concrete Sewers

122. Every engineer and contractor should have a copy of the 48-page book "Concrete Sewers" in his library. This valuable text, published by the Portland Cement Assn., 33 W. Grand Ave., Chicago 33, Ill., gives an authoritative discussion of hydraulics, sewer design, construction and maintenance. Generous use of helpful illustrations makes the book attractive and helpful to the reader. For your copy, just check the handy coupon.

Design Data for the Spiraflo Clarifier

124. Be sure to investigate the advantages of the Spiraflo clarifier for sewage treatment. Full engineering data, description of the unit, test results and specifications are offered in 24-page Bulletin 122 by Lakeside Engineering Corp., 222 W. Adams St., Chicago, Ill. Check the coupon today.

Comminutors for Automatic Disposal of Coarse Sewage Solids

152. The problems connected with disposal of coarse sewage solids are eliminated by clean, odorless, automatic Comminutors. Full engineering data show the proper model for every size plant and furnish details of hydraulics and typical installations. Chicago Pump Co., 622 Diversey Pkwy., Chicago 14, Ill.

Low Cost Power From Dual Fuel Engines

154. Operating on the Diesel cycle, burning either oil of gas, the Worthington Supercharged Dual Fuel Diesels give high economies by running on the cheapest fuel available. Get complete data from Worthington Corp., D. of PW, Harrison, N. J.

Design Data for Insulated Piping

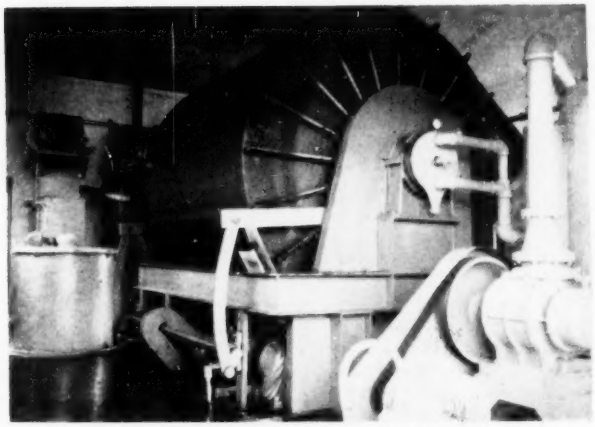
188. For all jobs where insulated piping is required you will want full design data on Ric-wiL Prefabricated Insulated Piping. Get 28-page catalog from the Ric-wiL Co., Barberton, Ohio, for details on both underground and overhead lines.

SOLVE YOUR SLUDGE DEWATERING PROBLEMS

THE KOMLINE-SANDERSON

COILFILTER

Non-clogging sludge-filter for improved vacuum filtration



Komline-Sanderson COILFILTER installed at Glen Cove, L. I., N.Y.
Consulting Engineer was Fred J. Biele, Huntington, N. Y.

4 reasons for its selections:

Operators are demanding and Engineers are specifying the Coilfilter for sludge dewatering on a practically unanimous basis, for these 4 reasons:

1. When the plants are started, there are no operational embarrassments for the Consulting Engineer.
2. With regard to operating reliability, the Coilfilter is completely superior to any other type of vacuum filter.
3. Definite savings are made in the use of chemicals.
4. The warranty made by the manufacturer, including maintenance of the filter media without charge for a ten year period.

Consulting Engineers are invited to consult us on sludge dewatering problems and allied matters of plant design and equipment selection. No obligation, of course.

EVERY INSTALLATION AN UNQUALIFIED SUCCESS BECAUSE:

FIRST

1. 50% greater cake output—continuously.
2. Guaranteed not to clog or blind under any condition of operation.
3. Continuous operation.
4. *Permanent* type filter media.
5. Satisfied operators.

SECOND

KOMLINE-SANDERSON Equipment provides complete installations for treatment of all sludges from sewage and industrial wastes, including

- Detailed engineering and installation drawings.
- Wet Type Chemical Feeders and Pumps.
- Rubber lined tanks for chemical storage.

KOMLINE-SANDERSON
ENGINEERING CORPORATION
Manufacturers of Dewatering and Drying Machinery
PEAPACK, N. J.

Advance design features make

Allis-Chalmers Tractors performance leaders

It takes truly modern equipment to keep pace with today's stepped-up demands — and do it at an operating cost which insures fair and consistent profits. The line of Allis-Chalmers crawler tractors has been designed and built completely new since the war, with the kind of advanced engineering that delivers big-capacity performance at a minimum of maintenance expense.

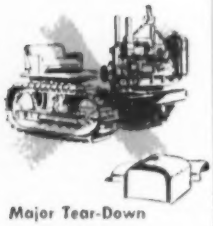
This forward progress is a continuing program. Additional improvements are constantly being incorporated into the HD-5, HD-9, HD-15 and HD-20 tractors. If you are in the market or just interested, see your Allis-Chalmers dealer for all the inside facts that have proved so popular with owners as well as operators and mechanics.

Daily Lubrication

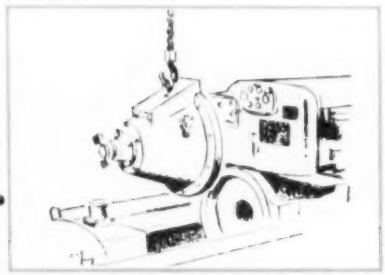
1000-hour Lubrication. Operate six months on a 40-hour week basis with just one lubrication of truck wheels, front idlers and support rollers. Positive seals protect from dust, loose sand, soft ground, mud or water. You gain working time, save labor and lubricant costs, eliminate costly damage from greasing neglect.

Ordinary Steering Clutches

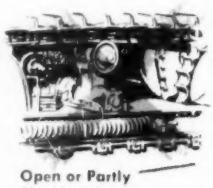
Hydraulic Steering and Self-Energizing Brakes. The HD-15 and HD-20 have hydraulic booster steering: operator exerts only 3 to 5 lb. pressure on controls, so he gets small tractor maneuverability from these 27,850 and 41,000 crawlers. Self-energizing brakes need less pedal pressure, take hold with a firm, uniform grip.



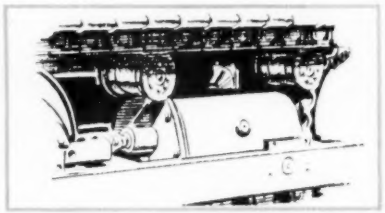
Major Tear-Down



Unit Servicing. No need to remove transmission or engine, radiator, grille, etc., when servicing or removing an Allis-Chalmers master clutch. The unit assembly principle also applies to final drive gear, transmission, steering clutches, engine and truck frame. Save hours of costly service and down time.

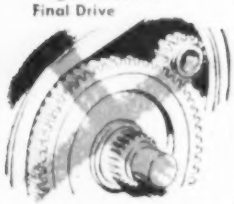


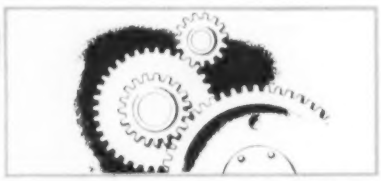
Open or Partly Shielded Track Release Mechanism



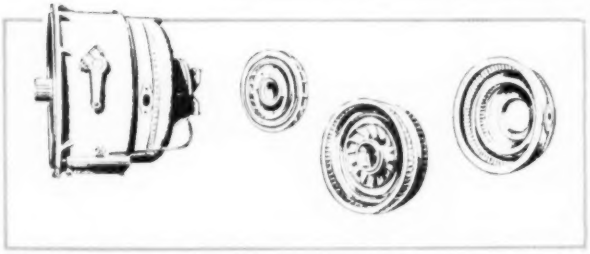
Oil Enclosed Track Release Mechanism. Operating in oil and *sealed* against dirt and moisture, Allis-Chalmers track release mechanism seals out mud, ice and debris. Because it's completely sealed, release mechanism is in working condition at all times — providing positive protection when obstacles jam into the tracks.

Single Reduction Final Drive





Double Reduction Final Drive. With smaller gears and shorter shafts, double reduction final drives provide better bearing and gear alignment. The "live" axle permits smaller, more serviceable seals. Equally important, double reduction drive provides for smooth, clean bottom construction and the extra ground clearance so necessary on rough terrain.



Hydraulic Torque Converter Drive. The HD-20 is the only crawler tractor where torque converter is standard equipment and part of the basic design. Torque converter gives greater pay load capacity because this unit automatically balances travel speed to the load. And with most shifting eliminated, there's far less operator fatigue.

ALLIS-CHALMERS
TRACTOR DIVISION — MILWAUKEE 1, U. S. A.

ORIGINATOR OF THE TORQUE CONVERTER TRACTOR

Non-Clogging Vertical Wet-Pit Pump Described

182. Full engineering data on Worthington "Freeflo" wet-pit pumps with non-clogging impellers capable of passing solids and stringy material are included in Bulletin W-317-B12. Check these pumps for sump, sewage and drainage service. Bulletin available from Worthington Corp., Harrison, N. J. Just use the coupon.

Complete Data On Sludge Pumps

193. Sludge pumps, simplex, duplex, triplex and quadruplex, normal and heavy duty models, are described in Bulletin S48 issued by Marlow Pumps, Ridgewood, N. J. Check the handy coupon for your free copy.

How Vacuum Filters Help Your Sewage Sludge Disposal

209. Applications of the Conkey sludge filter to all types of sewage sludge are described in Bulletin 100. Tables show filter sizes, weights, and give anticipated average results. Use the coupon to order your copy. General American Transportation Corp., Process Equip. Div., New York 17, N. Y.

Porous Media Handbook For Sanitary Engineers

222. A really helpful 56-page booklet just published by the Carborundum Company tells the complete story of the use of porous media in the fields of water and sewage treatment. The major portions are devoted to water filtration and air diffusion for activated sludge treatment. Diagrams show the many installation methods used, and full data is provided for the designing engineer. General data and specification sections complete this valuable reference bulletin. Get Form 5118 by checking coupon or write The Carborundum Co., Refractories Div., Perth Amboy, N. J.

Efficient Blowers for Activated Sludge Plants

232. Many advantages of Roots-Connersville positive displacement rotary blowers are described in Bulletin 22-23-B-13, which also provides characteristic curves for operation with constant speed, multi-speed and variable speed motors and details of several types of blowers. Get this helpful bulletin by checking the coupon. Roots-Connersville Blower Corp., Connersville, Ind.

Vacuum Filters Feature Easy, Non-Clog Operation

241. Get full data on vacuum filters using double layers of continuous coil springs that insure continuous, non-clog operaiton. Coils are automatically cleaned at each revolution. Komline-Sanderson Engineering Corp., Peapack, N. J.

Book Tells How to Control Root Stoppages

249. Details on the proven use of copper sulfate to control root and fungous growths in sewers are contained in a brand-new book published by Phelps Dodge Refining Co., 40 Wall St., New York 5, N. Y.

●

WATER WORKS

Complete Sanitation and Process Equipment Bulletin

40. A complete illustrated bulletin gives detailed information on all "Rex" sanitation and process equipment. 36 pages of engineering data, process descriptions, conversion factors. Get Bulletin 51-83 by checking the coupon. Chain Belt Co., Box 2022, Milwaukee 1, Wis.

Efficient Coagulation With Ferri-Floc

69. Advantages claimed for Ferri-Floc as a coagulant include wide pH range, quick floc formation, manganese removal, control of certain tastes and odors, plus other aids in high quality water production. Check coupon for complete Ferri-Floc data. Tennessee Corp., Grant Bldg., Atlanta, Ga.

To order these helpful booklets check the coupon on page 32.

The Turbidimeter Without Standards

51. The Hellige Turbidimeter is designed for accurate measurement of water turbidity, sulfate determinations, and measurements of suspended solids and colloids in general. No standards must be prepared for use with this instrument. Detailed description of working principle and the instrument itself covered in Catalog 8000-A, available from Hellige, Inc., 877 Stewart Ave., Garden City, N. Y., or by checking handy coupon.

Painting Water Tanks For Longer Protection

52. High labor costs demand special consideration when painting elevated water tanks. This and other factors involved in proper paint selection are discussed in a bulletin issued by Jos. Dixon Crucible Co., Jersey City 3, N. J. Helpful specifications for repainting water tanks are also included. Check the coupon today.

Turbidity Color and Hardness Removal

56. Modern water pre-treatment with Dorr equipment and methods is described in Bulletin No. 9141, which gives basic design data and flowsheets for pre-treating highly turbid water, color removal or treatment of low turbidity, and softening. Typical analyses for various types of waters are given together with detention times in recommended treatment units. Write The Dorr Co., Dept. PW, Barry Pl., Stamford, Conn.

How Engineers and Contractors Can Get This Comprehensive Water Control Apparatus Catalog

141. A 250-page catalog showng the full scope of Rodney Hunt water control apparatus is now available for distribution to consulting engineers, contractors and others actively engaged in water control construction work. Hundreds of diagrams, detailed descriptions and specifications show all types of sluice gates and related items, and a special section provides helpful engineering data. Send your request on business letterhead or use the coupon, stating your occupation. Rodney Hunt Machine Co., 7 Water St., Orange, Mass.

Design Data on Chemical Flocculating Equipment

89. Flash mixers, Straightline mixers, conveyors and elevators for handling chemicals are described in an illustrated bulletin now available from Link-Belt Co., Colmar, Pa. Selection tables and diagrams are provided to help you select the equipment best suited to your needs. Check the coupon for your copy.

Floatless Liquid Level Controls

92. Complete descriptions of electrode type floatless liquid level control systems, including control units, electrodes and fittings, panel assemblies and diagrams of typical installations for all types of municipal service are covered in the 32-page catalog of Charles F. Warrick Co., 1956 W. Eleven Mile Rd., Berkley, Mich. Check coupon for your copy.

Methods of Chlorinator Control

98. Chlorinator control methods include manual, semi-automatic, program, rate, fully automatic proportional and split feed control. To assist the chlorinator user and his engineer or technical adviser in the selection of the control method best suited for each requirement, a publication of Wallace & Tiernan, Inc., describes these methods in detail. You can get a copy of Publication TA-1013-C by checking the coupon.

Useful Data on Butterfly Valves

100. Complete descriptions and tables of dimensions on the full line of Rockwell Butterfly Valves is contained in several bulletins published by the company. Construction details and special control features are illustrated. Write W. S. Rockwell Co., 200 Eliot Street, Fairfield, Conn.

Tested Jointing Materials

102. "Hydrutite" is a self-caulking, self-sealing joint compound for bell and spigot pipes. For data book and sample write Hydraulic Development Corp., 50 Church St., New York, N. Y.

96 Page Book Helps Solve Water Problems

71 pH and Chlorine Control. A discussion of pH control and description of comparators, colorimeters and similar devices. A 96 page booklet. W. A. Taylor & Co., 7304 York Road, Baltimore 4, Md.

Propeloflo Meters Check Water Usage

104. Water saving programs start with flow data, and the versatile Propeloflo meter will get the facts you need. Available for lines 2" to 36" in diameter or larger, with electrical or mechanical remote indicating, recording and totalizing. All the facts in Bulletin 380-G2A from Builders-Providence, Inc., 356 Harris Ave., Providence 1, R. I. Check the coupon today.

Pressure Pipe That Retains Capacity

106. Several bulletins describing the construction of pressure pipe, list of installations, carrying capacity tests, making service connections under pressure; and detail descriptions of several installations. Lock Joint Pipe Co., Box 269, East Orange, N. J.

Discussion of Ranney Method For Municipal Water Production

116. A very interesting study of municipal and industrial water supply problems and a complete discussion of Ranney Collectors for water production will be found in a 20-page booklet published by Ranney Method Water Supplies, Inc., Box 277, Columbus 9, Ohio. Water quality, construction methods, costs, performance and other topics are considered. Check the coupon to get your copy.

Engineering Data on Diatomite Filters

139. Get complete data on the Sparkler model SC-J diatomite slurry feed filter for swimming pools from the Sparkler Mfg. Co., Mundelein, Ill. Check the coupon for full information including table of filter sizes and capacities, space required and filter operation.

Niagara Falls selects ALOXITE® underdrains

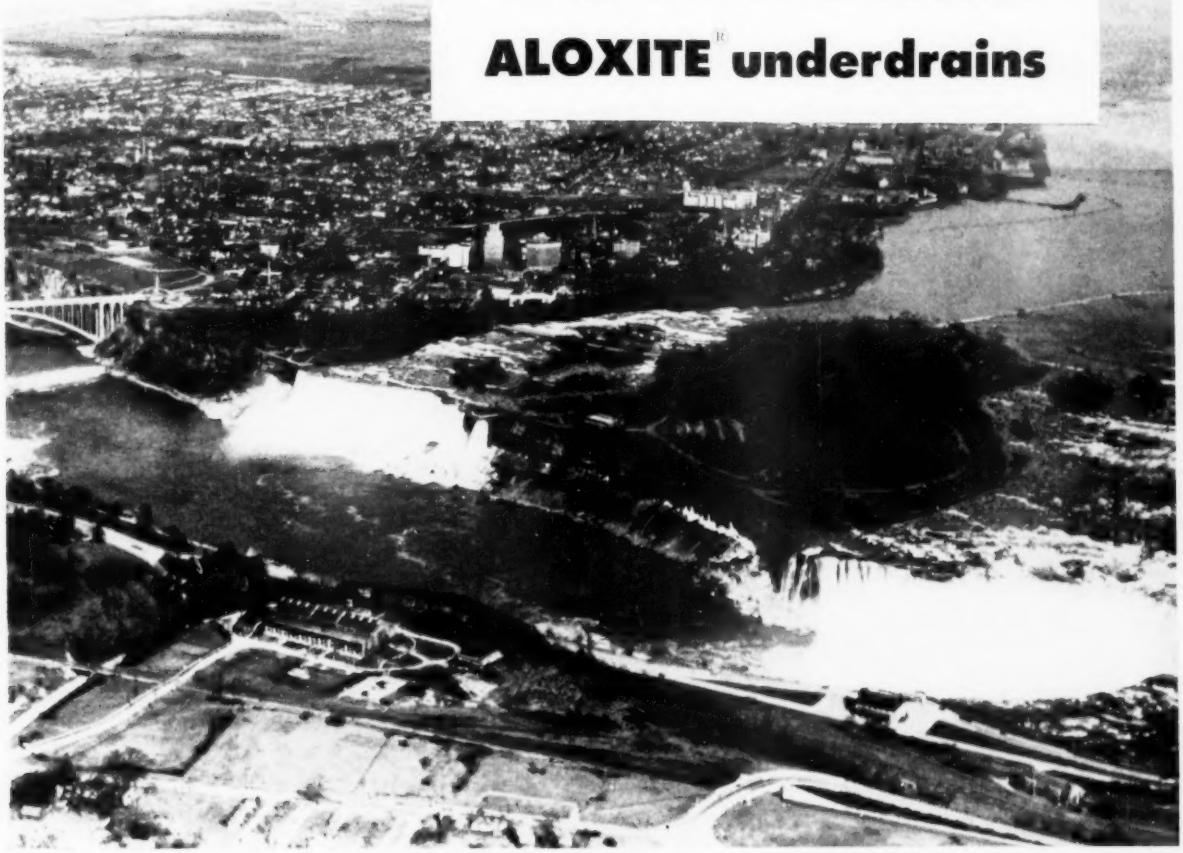


Photo courtesy Bell Aircraft Corp., Niagara Falls, N. Y.

Within the past ten years Niagara Falls has grown tremendously. Industries have expanded. Population has soared. And, of course, water consumption has grown apace. It may seem a paradox, but the site of the world-famous falls recently was faced with an extremely tight water-supply situation.

When it became apparent that their filter capacity needed expanding, the City retained consultants to make a thorough investigation. They checked on modernizing the old plant but decided—in view of future needs—that the first step should be a new plant. Then came design and selection of the most up-to-date equipment available. In the case of filter bottoms, the field narrowed to three types. And, we are proud to say, ALOXITE aluminum oxide plates were selected.

Niagara Falls and their consultants are to be congratulated for their careful study of the filtration problem. It will bear fruit in the operation of their fine, new plant. The porous underdrain plates, as our contribution, will help materially in gaining high operating efficiency, and easy, low-cost maintenance.

Credit is due Mr. H. R. Cheek—City Manager; Mr. J. T. Fish—Director of Water Dept.; Greeley and Hansen—Engineers (Chicago, Ill.); and Roberts Filter Mfg. Co.—Contractors (Darby, Pa.)

FREE — Send for this useful 56 page booklet. It describes the different systems of filtration and diffusion—tells how to specify, order, install, operate and maintain. Address Dept. W-93, Refractories Div., The Carborundum Co., Perth Amboy, N. J.

CARBORUNDUM
Registered Trade Mark

Now's the time to mail this month's Readers' Service card.

To order these helpful booklets check the coupon on page 32.

Makes Underground Pipe Installations Easy

115. One-man operated hydraulic pipe pusher pushes pipe through ground under streets, sidewalks, lawns and other obstacles. Pays for itself in man hours saved on first few jobs. For complete facts ask for Form E-213, Greenlee Tool Co., Rockford, Ill. Just check the coupon.

How Accurate Boring Speeds Underground Pipe Installations

135. Interesting charts showing earth boring costs, speed and accuracy for holes from 2½" to 14½" diameter and up to 80 feet long are included in 16-page Catalog No. 8 issued by Hydrauger Corp., 681 Market St., San Francisco 5, Calif. Specifications and general operating instructions are also covered.

How Your Filter Washing Can Be Improved

136. More thorough sand washing with the elimination of mud balls and cracking with resultant longer filter runs are claimed for the Palmer Filter Bed Agitator, described in bulletins issued by the Palmer Filter Equipment Co., P. O. Box 1655, Erie, Pa.

Helpful Data on Mechanical Joints

138. Get Circular 49 from M & H Valve & Fittings Co. for important information and installation dimensions of **M & H AWWA** Mechanical Joint Valves and Hydrants. Features include ease of installation, construction economy, long life. Use coupon or write M & H Valve & Fittings Co., Anniston, Ala.

Pollution-Proof Outdoor Drinking Fountain

144. An outdoor drinking fountain so designed that contamination by cross connections or back siphonage is not possible is fully described in a 4-page bulletin. Features neat appearance, easy installation. Write Murdock Mfg. & Supply Co., 426 Plum St., Cincinnati 2, Ohio, or use coupon.

Pipe Detector Determines Exact Location and Depth

120. Determination of the exact location and depth of buried pipes, valves, service cables and other metallic objects can save costly digging and unnecessary damage. Your work can be speeded when you use the Detectron pipe detector, which features simple operation, shielding to avoid static interference, economical unit construction and a lifetime guarantee. Get full data from Detectron Co., 5631 Cahuenga Blvd., No. Hollywood, Calif., by using the coupon.

How to Design Chemical Feed Systems

179. In a 12-page booklet published by Proportioneers, the many factors which enter into the design of a chemical feed system are discussed, and the types of systems used described in detail. These include dry feed, both volumetric and gravimetric and solution feed of the decanter and positive displacement pump types. Feeder controls are considered in detail. Send now for File No. RP-9080 by checking coupon. Proportioneers, Inc., Providence 1, R. I.

Water Lines Under Pavements Easily Installed

247. With a Trojan pipe pusher and puller no resetting of grip is required, so the work goes twice as fast. Two models, for pipe up to 2" dia. Get full details by checking the coupon. Trojan Mfg. Co., 114 Race St., Troy, Ohio.

Attractive Bulletin Features Large Elevated Tanks

252. In a 24-page booklet, "Horton Elevated Steel Tanks of Large Capacity," Chicago Bridge & Iron Co., Chicago 4, Ill., describes the advantages of using large elevated steel tanks to provide gravity pressure in municipal water systems. Detailed information on radial-cone tanks of 500,000 to 3,000,000-gal. capacity and Horton-spheroidal tanks of 1,000,000 to 3,000,000 gal. is included in this really handsome bulletin. Check coupon for your copy.

Pipe-Laying Instruction Booklet Is Easy to Read

149. A new pipe-laying instruction booklet, written in straightforward language, explains every operation in laying concrete pressure pipe. "How-to" photographs and simplified diagrams show just how the job should be handled. Get copies of this 16-page booklet from Price Brothers Co., Dayton, Ohio, by checking the coupon.

Inserting Valves Without Shutdown

162. Do you have the latest data on equipment for inserting control valves where shutdown is impractical? Mueller catalogs H-20 and H-602 give all details on inserting valves and equipment, using hand-operated or power-operated machines. Get these catalogs today by checking the coupon. Mueller Co., Decatur, Ill.

What You Should Know About Meter Setting and Testing Equipment

166. Complete details on all equipment and proper methods for meter testing and installation are included in an excellent book published by Ford Meter Box Co., Wabash, Ind. All waterworks men concerned with setting and testing of water meters should have a copy of this book. Write for Catalog No. 50.

All About Centrifugal Pumps

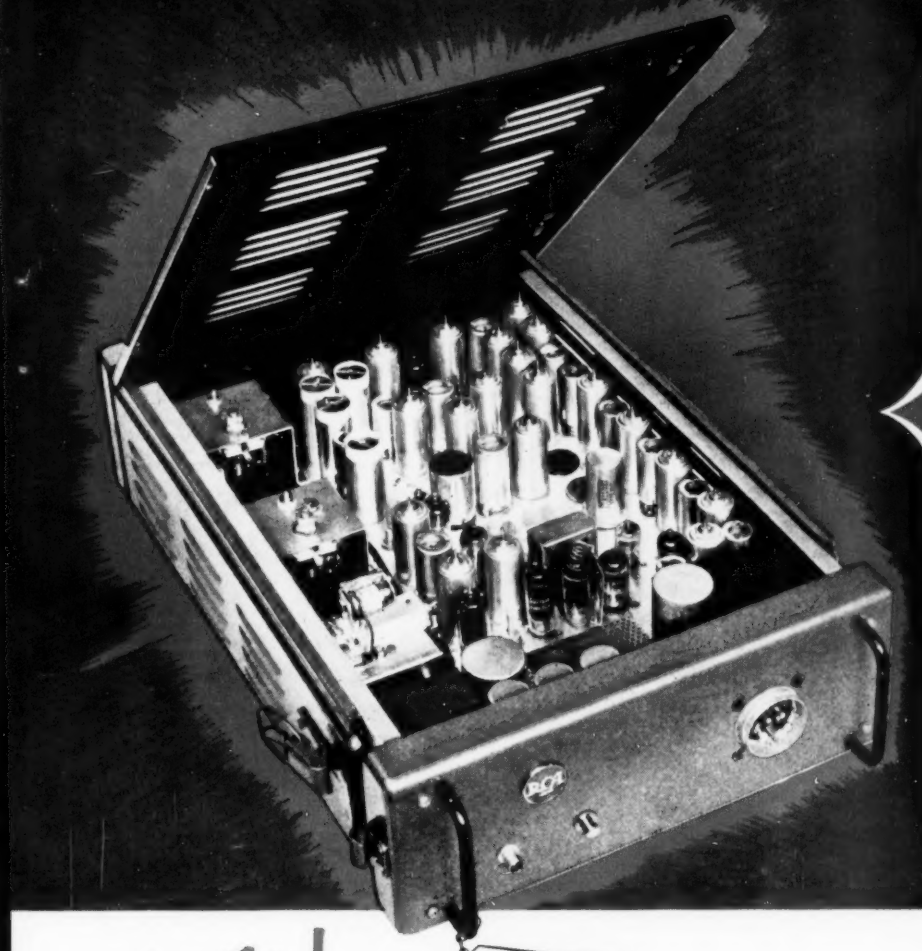
258 Where pumping performance counts you want to check your specifications carefully. Investigate the features of Fairbanks-Morse centrifugals. Use coupon or write to Fairbanks, Morse & Co., Dept. PW, Chicago 5, Ill.

Reference Book on Lubricated Plug Valves

273. Lubricated plug valves, including stick-proof lever sealed valves for easy operation and positive mechanical seal are fully described in reference books issued by Homestead Valve Mfg. Co., Box 550, Coraopolis, Pa. Check the coupon for your copy.

It's a fact . . . our handy Readers' Service card is the way to get new catalogs.

Get these 7 ALL-NEW FEATURES with RCA UHF 2-Way Radio

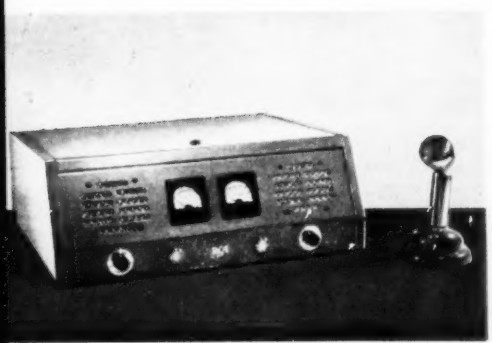


1. Low-cost tubes.
2. Improved coverage in city areas. Less noise, less absorption of signal.
3. High-efficiency power supply.
4. Optional operation on as many as four frequencies.
5. Built-in metering sockets to speed service.
6. 6-inch antenna to simplify installation.
7. "Split" drawer design for easy maintenance.

NEW RCA UHF 2-WAY RADIO

opens up traffic-free channels

PERMITS "UNCROWDED OPERATION"



IF YOU'VE been putting off 2-way radio . . . if you're now operating on an overloaded frequency . . . here's RCA 2-way radio equipment which utilizes many new uncongested channels in the Ultra High Frequency Band, 450-470 megacycles.

NOISE-FREE RECEPTION

With RCA 2-way radio, you eliminate most man-made and natural electrical noise, cut out ignition interference and assure top performance in severe noise areas.

PROVED IN ACTUAL FIELD USE

The UHF equipment, engineered to highest RCA standards, has proved its merit in actual field use in five important systems. The new RCA UHF equipment is ready now to help you solve your problem of channel overloading.

FOR NEW FREEDOM in radio operations check RCA Ultra High Frequency 2-way radio. MAIL COUPON NOW.

Radio Corporation of America
Communications Equipment Dept. 133U
Building 15-1, Camden, N. J.
In Canada: RCA Victor Company Limited, Montreal

Please send me information of RCA Ultra High Frequency (450-470 mc) 2-way radio.

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____

STATE _____

RADIO CORPORATION of AMERICA
COMMUNICATIONS EQUIPMENT — CAMDEN, N. J.

To order these helpful booklets check the coupon on page 32.

Get full details of this month's products . . . mail your Readers' Service card today.

Engineering Data On Gravity Filter Design

170. The complete line of gravity filters and related accessories furnished by the Permutit Co., New York 36, N. Y., is covered in a well-illustrated 24-page booklet. Each element of a filter and filter controls are discussed in detail to assist the designer of these important units. Get your copy of this helpful publication by checking the coupon.

Pressure Reducing Regulator Has High Inlet-to-Outlet Ratio

172. Get full data on the 50-G2 pressure reducing regulator that permits inlet-to-outlet ratios of 250 to 2 lbs. at accuracies approaching instrument control. Bulletin G-101, available from Foster Engineering Co., 825 Lehigh Ave., Union, N. J. gives full details. Check the coupon.

Modern Convenience for Lead Melting and Soldering

196. Insto-Gas torches and furnaces give trouble-free service for lead melting, soldering and all other jobs where a steady, clean, hot flame is needed. Convenient cylinders require no regulating gauges and attach directly to standard furnace assembly. Full details from Insto-Gas Corp., Detroit 7, Mich., by checking the coupon.

Indicating, Recording and Totalizing Meter

218. For accurate measurement of water, gas, air, sewage, sludge, etc., the Simplex Valve & Meter Co., Philadephia 42, Pa., has developed the Type H Meter. This mercury flow type indicating, recording and totalizing unit operates in conjunction with Venturi tubes, flow nozzles and orifice plates. Full description of this meter and installation data in comprehensive Bulletin 401, available by checking the coupon.

Helpful Data On Pipe Tools

230. Toledo drop head ratchet threaders are light, compact, ideally suited for work in tight corners. Three models for ⅛" to ¾"; ⅛" to 1¼"; and ½" to 2" pipe all feature quick change of sizes. Get Catalog 11a52 from Toledo Pipe Threading Machine Co., Toledo, Ohio. Check the coupon.

Complete Booklet on Pipe Line Equipment

246. Equipment for all types of jointing, maintenance and repair jobs on water, gas and sewer lines is described and illustrated in Catalog No. 25 issued by Joseph G. Pollard Co., New Hyde Park, N. Y. Leak detectors, pipe finders, melting kettles, cleaning tools and a full line of hand tools for water and sewer departments, and many other items are included. Be sure to get your copy now. Just check the coupon.

Handy Catalog Covers All Pipe Repairs

290. A complete catalog covering repair clamps, packings and gaskets of several designs to suit all needs is offered by Smith-Blair, Inc., So. San Francisco, Calif. Directions for use show ease of application. Every water works needs a copy of this catalog for ready reference. Available by using the coupon.

Factors to Consider in Elevated Tank Selection

299. Details on the several different types of elevated steel tanks, including capacity ranges, tank dimensions and other factors to be considered in the selection of elevated tanks for modern water storage, plus discussions of new tanks for old towers and foundations are included in Bulletin 101 of the Pittsburgh-Des Moines Steel Co., Neville Island, Pittsburgh, Pa. Check coupon for your copy.

Cleaning Service for Every Type of Pipe Line

302. Flexible Pipe Cleaning Co., operating with specialized equipment and trained crews, is prepared to remove scale, rust and other deposits from pipes for every type of service. For details and estimates furnished without obligation write Flexible Pipe Cleaning Co., Box 167, Los Nietos, Calif. or check the coupon.

HOW FORWARD-LOOKING COMPANIES

Make Costly Machines Earn More Dollars-Per-Hour!

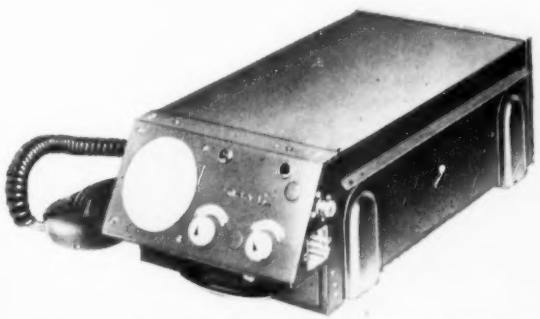
MOTOROLA 2-WAY RADIO

cuts "down time" and "deadheading"
—makes each day's operations more profitable with maximum use of equipment

Progressive companies are using Motorola 2-way radio to get greater day-by-day returns from their investment in equipment. Instant Motorola communications co-ordinates operations, reduces lost time, helps meet construction deadlines . . . reduces "deadheading." Costly breakdowns are reported in seconds. Improved efficiency of every piece of equipment pays for Motorola installations over and over again.

Eight exclusive Motorola features guarantee precision selectivity, time-tested durability, obsolescence-free design. Permakay, Motorola's permanent selectivity wave filter, eliminates 15 nuisance tuning adjustments forever. Get all the facts about this rugged, reliable communications tool. *Write to Dept. 2286-PW today!*

Construction foreman, operating base station console, maintains instant supervision, keeps progress report up to date, co-ordinates activities between crews.



Uni-Channel Sensicon Dispatcher serves as a fixed or mobile station. It's ruggedly built to take jolts and shocks of rough roads . . . obsolescence-proof circuits stay up to date for years to come.

2-way Radio

Motorola®

Communications & Electronics, Inc.

A SUBSIDIARY OF MOTOROLA, INC.

900 N. Kilbourn Ave., Chicago 51, Illinois • Rogers Majestic Electronics Ltd., Toronto, Canada

To order these helpful booklets check the coupons on page 32.

STREET LIGHTING

Investigate "Monotubes" For Modern Street Lighting

76. Monotube street lighting poles are offered in modern design for use with either incandescent or fluorescent luminaires on all street and highway lighting applications. For helpful information on these attractive and economical poles write to Union Metal Mfg. Co., Canton 5, Ohio, or check the coupon.

Mercury Vapor Lights Need Efficient Transformers

225. To get all the benefits of mercury vapor lamp illumination, efficient transformers are required. Complete data on Jefferson Transformers for all outdoor and indoor installations is offered in 16-page illustrated Bulletin 521-C by Jefferson Electric Co., Bellwood, Ill. Particular attention is given to street lighting applications. Get a copy now by checking the coupon.

CONSTRUCTION EQUIPMENT AND MATERIALS

What's Your Digging Problem? Repair Work? Trenches? Footings?

35. At today's prices, hand digging means the job will be costly. You can dig through asphalt and macadam, work fast and efficiently even in cramped areas with the tractor mounted Sherman Power Digger. From one position you can reach to dig 10 feet behind tractor in 140° arc and to depth of 8 feet. For full details check the coupon. Sherman Products, Inc., Royal Oak, Mich.

Easy Operation Featured for This Heavy-Duty Tractor

47. The Oliver OC-18, with 126 drawbar horsepower, is designed with nine "easy operating" features which contribute greater output on the job. Application photographs, diagrams and sketches as well as complete specifications are included in an attractive folder. For a copy write The Oliver Corp., 400 W. Madison St., Chicago 6, Ill. or use the coupon.

Blades For All Types Of Equipment

60. Get information now on long-wearing blades for graders, scrapers, bulldozers, snow plows and scoops; snow plow noses and runners; scarifier teeth and numerous other products for road machinery. Check coupon or write to Paper-Calmenson & Co., St Paul 8, Minn.

What You Should Know About Air-Placed Concrete

67. For a detailed explanation of the principle of "gunned" or "air placed" concrete and description of the improved Model 750 and 1250 Bondactors, be sure to get your copy of Form 553 from Air Placement Equipment Co., 1011 W. 24th St., Kansas City 8, Mo. Check the coupon today.

Check Your Power Needs Without Delay

68. International Harvester Company has available a folder describing its line of diesel engines and power units for all your power needs up to 180 hp. For a copy of this colorful booklet, write to International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., and ask for Form A-156-NN, or use the handy coupon and we will forward your request.

Inexpensive Ditcher Handles Heavy Digging

91. The Shawnee Scout Ditcher, a new, heavier model for extensive digging has been added to the Shawnee line of ditchers and dozers. All models are designed to handle ditching and backfilling operations quickly, efficiently and at low cost. Full information on this equipment will be sent by Shawnee Mfg. Co., 1947 N. Topeka, Topeka, Kansas. Just check the coupon.

"Encyclopedia" on Bulldozers

97. Every size and style of bulldozer made by Caterpillar Tractor Co., Peoria 8, Ill. is shown in a 36-page booklet, Form 30461. Cutaway views showing details, important components of hydraulic and cable controls, attachments such as brush, root and rock rakes, treedozers and stumpers are also included. Get this interesting publication by checking the coupon.

Booklet Helps Design of Custom-Engineered Steel Buildings

110. Custom-engineered Butler steel buildings are available in every size, type and design to meet your building needs. In a helpful 32-page booklet you will find details on several basic designs and an unlimited variety of door, window and interior treatments; answers to your questions on construction and erection; and many illustrations of typical uses. Use the coupon or write to Butler Mfg. Co., Kansas City, Mo.

Helpful Booklet on Carryable Centrifugal Pumps

129. A booklet prepared to give practical information that will guide you in choosing the best type of pump for your requirements is offered by the Homelite Corp. Both gasoline and electric models are discussed, and requirements outlined for many applications. Just check the coupon for your copy. The Homelite Corp., 2125 Riverdale Ave., Port Chester, N. Y.

Drill Concrete With Your Ordinary Electric Drill

295. Substantial cost-per-hole savings are claimed for Tilden Rotary Drills which penetrate 2" to 4" per minute. Available in sizes ¼" to 4". Cutters can be resharpened. Full data from Tilden Tool Co., 209 Los Molinos, San Clemente, Calif. Just check the coupon.

To order these helpful booklets check the coupon on page 32.

Details on Motor Grader Construction and Use

312. In a handsome catalog, profusely illustrated with diagrams and photographs of unusually fine quality, the Galion Iron Works and Mfg. Co., Galion, Ohio, has presented all details on the construction and operating features of their Model 118 motor grader. This impressive 28-page catalog, No. 375, is available without charge. Just check the coupon.

The Loader That Digs Like a Power Shovel

317. The power crowder arm of the Lessmann loader gives you power shovel advantages in this tractor-mounted unit, and enables you to fill the bucket in tough digging without spinning the wheels. Check the coupon for all the details on this rugged, heavy-duty unit. Lessmann Mfg. Co., Des Moines 4, Iowa.

●

WEED CONTROL

Better Mowing and Brush Removal

30. Fast, versatile Wood rotary mowers are available in seven models to suit all types of municipal maintenance. Upkeep costs for roadside mowing, brush cutting, leaf mulching, park maintenance can all be reduced with efficient equipment. Get full details by checking the coupon. Wood Bros. Mfg. Co., Box 1488, Oregon, Ill.

Chemical Weed Killers Are Fast and Effective

117. Be sure to check Polybor-Chlorate and concentrated Borascu for fast, economical non-selective destruction of weeds and grasses. Features and applications of these effective products are outlined in bulletins available from Pacific Coast Borax Co., 630 Shatto Pl., Los Angeles 5, Calif. Check coupon for full data.

What You Should Know About Chemical Weed Control

132. In a convenient 44-page book, the C. B. Dolge Co. gives full details on spraying procedures and chemicals to use for control of lawn and roadside weeds, ragweed eradication and insect control in turf. Get your copy by checking the coupon or write C. B. Dolge Co., Westport, Conn.

●

TRAFFIC SIGNS

New Reflectorized Sign Faces Refurbish Old Traffic Signs

292. Get complete details on new "EZ-On" traffic signs faces ready for immediate shipments. Reflectorized faces cost only a fraction as much as new signs and are easily attached to existing traffic signs. Use the coupon for data today. Grace Sign & Mfg. Co., St. Louis 18, Mo.

How Reflective Sheeting Improves Traffic Signs

157. Get full data on Grotelite reflective sheeting for smooth, brilliant, long-life traffic signs and marking devices from the Grote Mfg. Co., Bellevue, Ky. Use the handy card or coupon today.

●

STREETS AND HIGHWAYS

Do You Have Complete Black Top Equipment Data?

41. In 36-page catalog AA a full line of maintenance is covered. Units described and illustrated include several models of pressure distributors, supply tanks, sprayers, brooms, asphalt kettles, portable rollers, and accessory tools. Use coupon for copy of this handy manual. Littleford Bros., 452 E. Pearl St., Cincinnati 2, Ohio.

Speed Concrete Removal And Make Better Patches

202. Felker self-propelled concrete cutters saw to 6½" depths to facilitate concrete removal and produce smooth, straight edges which resist spalling when patched. Full data on cutters and segmented type diamond abrasive wheels are available from Felker Mfg. Co., Torrance, Calif. Check the coupon today.

Self-Propelled Sidewalk Paver Lays Up to 10 Ft. per Minute

203. The Dotmar paver, which can lay up to 10 ft. per minute of sidewalk, may be converted readily to pave curb and gutter or integral curb, gutter and walk. Full details in 8-page Bulletin 52, released by Dotmar Industries, Inc., Kalamazoo, Mich. Just check the handy coupon.

Get Full Data On Aggregate Spreaders

231. Accurate control for spreading crushed rock, chips, sand or ice control materials is featured by all models of Highway Equipment Co. materials spreaders. Data on both trailer and tailboard types available by checking the coupon. Highway Equipment Co., 630 D. Ave., Cedar Rapids, Iowa.

Choosing Trucks For Municipal Service

264 For all municipal services, trucks are needed that are high in efficiency and economy. Be sure to investigate the White 3000, engineered for high performance. Full details on White Super Power trucks from the White Motor Company, Cleveland 1, Ohio.

Use Hot Patch Material On All Maintenance Jobs

297. With the Barber-Greene Mixall you can get hot patch material wherever and whenever you need it for all maintenance jobs. Send for new 8-page bulletin that gives full information on this small, highly portable unit that turns out all types of bituminous patch material in any quantity you need. Write Barber-Greene Co., Aurora, Ill., or use the coupon.

To order these helpful booklets check the coupon on page 32.

Helpful Manual on Bodies and Hoists

101. The Heil Body and Hoist Manual is a handy 68-page booklet designed to furnish all information needed for selection of the correct body and hoist unit for your needs. Body and hoist features, payload distribution, hoist capacities and full operating and maintenance instruction are a few of the items covered in this comprehensive manual. Check coupon or write The Heil Co., Milwaukee, Wis.

Faster Compaction On Street Repairs

108. Holes and trenches cut through pavement present difficult areas for compaction of backfill. Learn how to do the job quickly, easily and cheaply by using the self-contained, portable Barco Rammer. Full data on this low cost will be found in Bulletin 621. Write Barco Mfg. Co., 500 No. Hough St., Barrington, Ill., or check the coupon.

Manual on Retaining Wall Design

160. Embankment stabilization with Armco Bin-Type Retaining Walls is discussed in a 16-page illustrated booklet offered by Armco Drainage and Metal Products, Inc., Middletown, Ohio. Included are case histories which show embankments along highways, lakes, streams and city streets. Technical data covers selection of design and units required for various sections, curves and grades. Use the handy coupon.

Patching and Maintenance With Bitumuls

283. Proper maintenance of paved surfaces is the subject of an informative 24-page booklet "Bitumuls for Maintenance" published by American Bitumuls & Asphalt Co., 200 Bush St., San Francisco 4, Calif. Profusely illustrated and well-written, this text gives step-by-step descriptions of patching and other surface maintenance operations. Check the coupon now to order your copy.

How to Get Better Concrete Construction

198. A comprehensive report on the use of "Pozzolith" as a means of increasing the strength and durability and reducing the permeability of concrete structures, while reducing costs at the same time, is presented in 32-page Bulletin LH 9-52 of Master Builders Co., Cleveland 3, Ohio. Every engineer and contractor should study this helpful data. Check coupon for your copy.

How Aerial Surveys Fill All Map Needs

235. A clear explanation of the technique of aerial topographic map production is given in "Air Speeds Your Map Needs." Striking photographs trace aerial photos step-by-step to the final maps for highway location, city and regional zoning and planning, traffic studies, drainage and watershed projects, tax maps and many other types of work. Use the coupon to get this excellent booklet for public works and planning officials. Jack Ammann, Photogrammetric Engineers, 829 N. St. Mary's St., San Antonio 2, Texas.

Design Data on Universal Concrete Cribbing

274. Complete information on concrete cribbing for embankment retaining walls, bridge abutments, highway underpasses and other structures will be found in a new bulletin issued by the Universal Concrete Pipe Co., 297 S. High St., Columbus, Ohio. Check coupon for free copy.

Latest Data on Rubber Roads

296. A report covering all developments to date on the use of natural rubber in road surfacing of asphalt highways has been issued by the Natural Rubber Bureau, 1631 K St., N. W., Washington 6, D. C. Get your copy of this 52-page booklet which includes new data on research and full reports on test roads in many states. Use the handy coupon.

How the Mobil-Sweeper Can Improve Street Sweeping

305. Sweeping costs can be cut with the Mobil-Sweeper which features safe highway speeds up to 55 mph, carries 2 2/3 cu. yd. dirt hopper, sweeps swath up to 10' wide with full floating brooms. Hills and deep gutters are no obstacle. Write to The Conveyor Co., 3260 E. Slauson Ave., Los Angeles 58, Calif. or use coupon for complete details on this machine.

Easier Street Sweeping With Wilshire Municipal Sweepers

306. A handy chart included in a comprehensive 20-page bulletin enables you to check your street sweeping costs against the man-hour savings of all Wilshire power sweeper models. Other helpful information shows all details on sweepers for large and small communities. Get this illustrated bulletin by writing Wilshire Power Sweeper Co., Glendale 4, Calif., or check the coupon.

●

SNOW AND ICE CONTROL

Uniform Salt Spreading Saves Material

145. The wide, thin pattern provided by Tarco "Scotchman" spreaders avoids salt waste, saves time and labor. Get Folder BL for full details on this spreader and table of material application rates. Use coupon or write Tarrant Mfg. Co., Dept. PW, Saratoga Springs, N. Y.

Snow Plows for Every Street and Highway Need

335. For details on the full line of Frink Sno-Plows, including the new taper-type reversible plow with hydraulic roll-over control, reversible trip-blade plows, Vee plows and all accessories, check the coupon today. Frink Sno-Plows, Inc., Clayton, N. Y.

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SULPHUR-DIOXIDE HIGHEST QUALITY SO_2

SULPHUR-DIOXIDE

SULPHUR-DIOXIDE is effectively used for dechlorination in water treatment and to remove objectionable odors remaining after purification.

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COPPER SULPHATE

COPPER SULPHATE will control about 90% of the microorganisms normally encountered in water treatment plants more economically than any other chemical.

Ferri-Floc is a partially hydrated ferric sulphate. It is a stable, free flowing, granular salt. It can be fed with few modifications through any standard dry feed equipment. Being partially hydrated, it is mildly hygroscopic, thus permitting easy handling as well as long storage periods in closed hoppers.

Water Treatment

Coagulation of surface or well waters. Aids taste and odor control. Effective in lime soda-ash softening. Adaptable to treatment of nearly all industrial water or wastes.

Sewage Treatment

Coagulation over wide PH range. Efficient operation regardless of rapid variations of raw sewage. Effective for conditioning the sludge prior to vacuum filtration or drying on sand beds.

- ✓ ❶ Coagulation over wide PH ranges, color, turbidity and manganese removal.
- ✓ ❷ Rapid floc formation and rapid settling.
- ✓ ❸ Increased filter runs.
- ✓ ❹ Quality effluent low in iron and aluminum.
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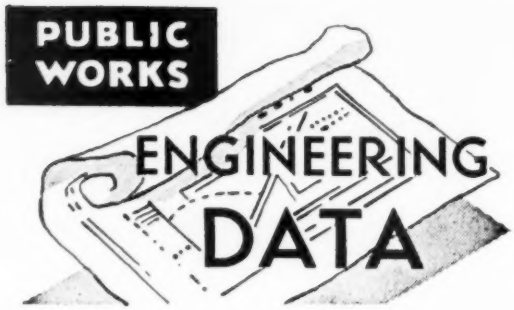


Milorganite Sales Are a Good Investment

An average reduction in BOD of 94 percent in 1951 was reported by the Milwaukee, Wisc., sewage treatment plant. Suspended solids removal was also 94 percent and bacterial reduction 93 percent. There were produced and sold during the year 64,422 tons of Milorganite. The returns from the sale of this product pay for its processing which represents about 60 percent of the cost of disposal plant operation. The 45 mgd plant addition begun in 1949, was placed in operation early in 1952, giving a total plant capacity of 200 mgd.

• • •

BOD Removals by Intermittent Sand Filters

Results of studies at the University of Florida of the performance of intermittent sand filters are reported in the quarterly "Sanitary Engineering Progress" published by the University. These recent studies show the amount of BOD removed at various levels of sand within the bed and confirm the high efficiency at which sand filters operate. The sand filter selected for this study is 7.4 feet square and is filled to a depth of 30 inches with a sand having an effective size of 0.31 mm. and a uniformity coefficient of 3.26. Sampling troughs were placed through the bed at 4″, 6″, 12″, 18″, and 24″ levels. The filter was loaded at a rate of 150,000 gallons per acre per day, applied in two equal doses at 9:00 a.m. and 3:00 p.m.

The average results shown in Chart 1 were obtained on samples taken only from the 9:00 a.m. influent and effluent.

Beginning May 1st, composite samples of the 9:00

Date 1953	BOD Applied p.p.m.	Per Cent BOD Removed at Sand Depth					
		4″	6″	12″	18″	24″	30″
March	115	74	83	90	92	96	97
April	99	71	82	90	92	96	98
May	82	61	76	82	---	---	99
June	57	63	75	79	---	---	99

Date	BOD Applied p.p.m.	Per Cent BOD Removal at Sand Depths					
		4″	6″	12″	18″	24″	30″
May	126	53	71	83	---	---	99
June	75	52	71	81	---	---	99

● **Chart 1 above, Chart 2 below, show BOD removals.**

a.m. and 3:00 p.m. loadings were taken of the influent at the 4", 6", 12" and 30" levels. These were in addition to the 9:00 a.m. samples. The average results were as shown in Chart 2.

• • •

Red Stop Signs Urged

There is a growing conviction on the part of highway safety experts to favor red stop signs over the present yellow color in an effort to cut down motor vehicle accidents. This is the word from Harry E. Neal, chairman of the traffic committee of the American Association of State Highway Officials.

The changeover would by no means be an innovation in traffic control. South Dakota was the first state to adopt over-all red stop signs at arterial and boulevard intersections.

California has been using a familiar red octagon on its stop signs for many years—sometimes with the additional warning of a flashing red light in the center of the octagon. Illinois is one of several states planning to switch to a red stop panel, according to Neal.—The Highway Magazine.

• • •

Road Research in Great Britain

The report of the Road Research Laboratory of Britain's Department of Scientific and Industrial Research has been released covering 1952 work. Some of the highlights are given below, but a variety of subjects not mentioned here are covered. Copies of the entire report are available from British Information Services, 30 Rockefeller Plaza, N. Y., for $1.15.

Pedestrian Crossings—There was a decrease during 1952 of pedestrian casualties on the roads. The casualties decreased by 5373, or 9 per cent as compared with the figures for 1951. Deaths decreased by 335 (14 per cent) during the year. This improvement followed the change in pedestrian crossing regulations in October 1951 when pedestrian crossings were zebra-striped.

Soil Boring Machine—The Laboratory has developed a mechanical auger for investigating subsoil conditions particularly where stony or gravelly strata are encountered. The machine has successfully bored holes up to 2 ft. in diameter to a depth of 16 ft. in a wide range of soils and has aroused considerable interest both at home and abroad because of its application in many branches of civil engineering.

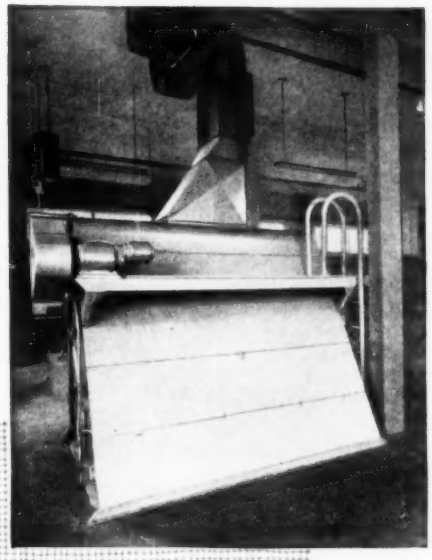
Traffic Signals—The Road Research Laboratory has been using a new computing machine to study the efficiency of traffic signals and the best setting of the light-changing mechanisms to reduce delay under various traffic conditions. The machine has been developed at the Laboratory and it uses a tape punched in accordance with the actual traffic flow observed at a junction. The computer records the total delay caused to traffic using the junction under varying settings of the traffic signal changes.

This new method of studying traffic behavior at signals is quicker and cheaper than direct observation and gives more reliable results than theoretical methods.

Snow Fences—A low-speed wind tunnel is being used to study the separate effects of the size of slats and the inclination of the slats to the wind, using model snow fences, in order to determine the best type of fences for forming drifts away from the road.

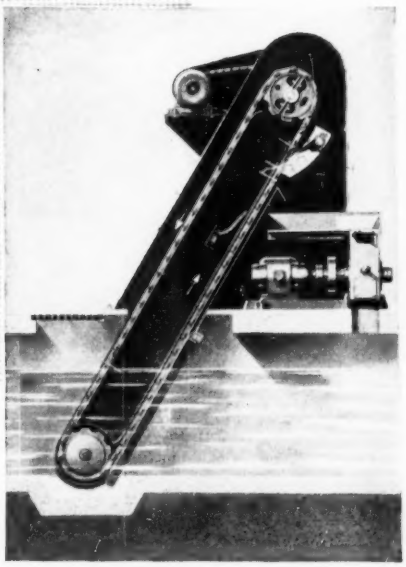
220 Cities can't be wrong!

REX FRONT CLEANED BAR SCREENS ARE BEST



because

Yes, 220 cities with over 300 installations offer proof of the leadership of Rex Front Cleaned Bar Screens. For over 20 years Rex Screens have been satisfying customers throughout the United States and in many foreign cities. Here are some of the outstanding proven features of Rex Screens that make them leaders in their field.



- **Streamlined Construction**—unobstructed flow to rack-guarded chain—streamlined sprockets.
- **Rigidly Fastened Bar Rack**—bars accurately spaced—no obstructing cross members.
- **Solid Plate Rake** with machined teeth for positive cleaning of bar rack and greater capacity.
- **Positive Rake Wiping**—quiet—adjustable—prevents screenings carry-over to downstream side.
- **Rex Z-Metal Chain** and attachments—corrosion and wear resisting.
- **Split Head Sprockets**—easily removable.
- **Efficient Drive Unit**—fully enclosed—shear pin protection against overload.
- **Fully Enclosed Screen**—rugged design—neat appearance—easy removal of screenings.
- **Low Cost**—original operating—maintenance.

Your Rex District Sales Engineer can give you the details on all of the advantages of Rex Front Cleaned Bar Screens. Call him today, or if you prefer, write to Chain Belt Company, 4722 W. Greenfield Avenue, Milwaukee 1, Wisconsin.

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Locks sheets to rigid steel frame

Typhoons and earthquakes have proved the superior protection given to building contents by Butler construction! Galvanized bolts lock specially-corrugated Butler galvanized or aluminum sheets to rigid steel framework. Sheet laps are bolted together for extra rigidity and weather-tightness. Precision-punched and dimensioned bolt holes assure fast, easy, low-cost field erection—and also assure 100 percent re-use of materials for building expansion or removal to a new location.

Extra protection against wind, rain and snow is provided by steel-backed Neoprene rubber washers.

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- Bolted construction
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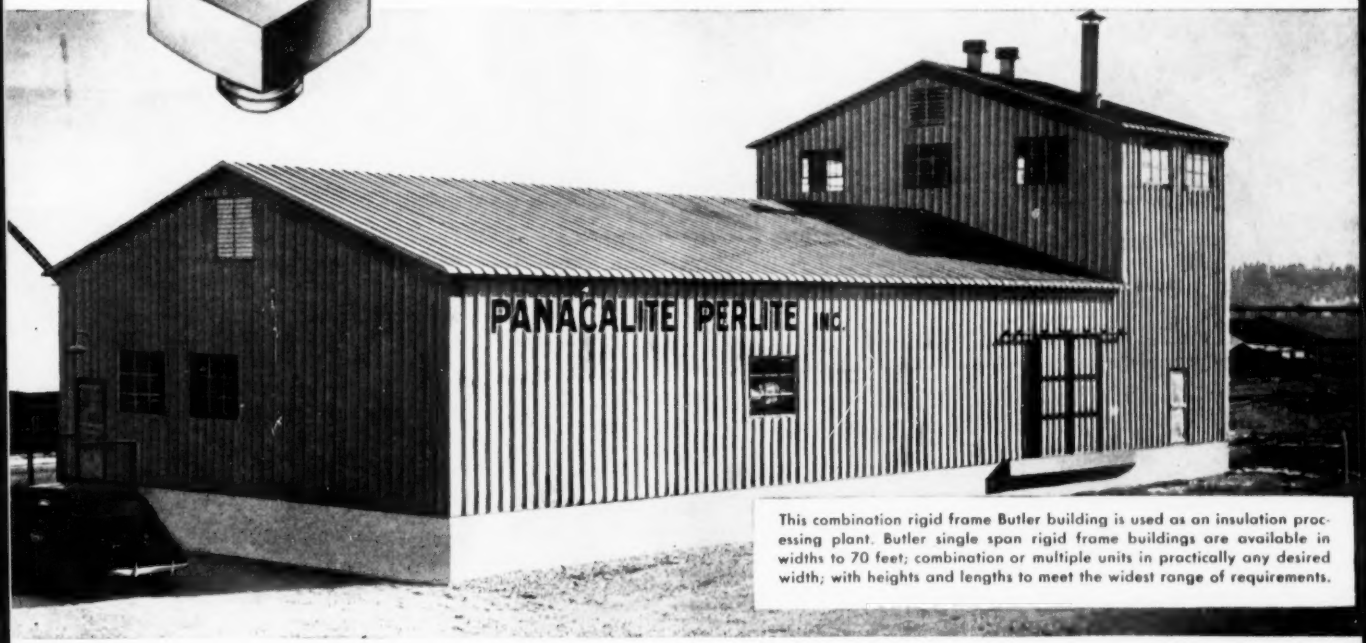
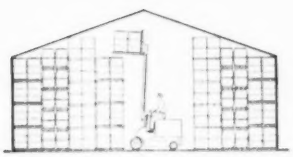
- Weather-sealed windows and base
- Die-formed curved eave sheets
- Sidewall sheets mitred for weathertight fit with eave sheets
- Weathertight stationary ventilators
- Easily insulated
- Complete adaptability to your door and window requirements



This combination rigid frame Butler building is used as an insulation processing plant. Butler single span rigid frame buildings are available in widths to 70 feet; combination or multiple units in practically any desired width; with heights and lengths to meet the widest range of requirements.



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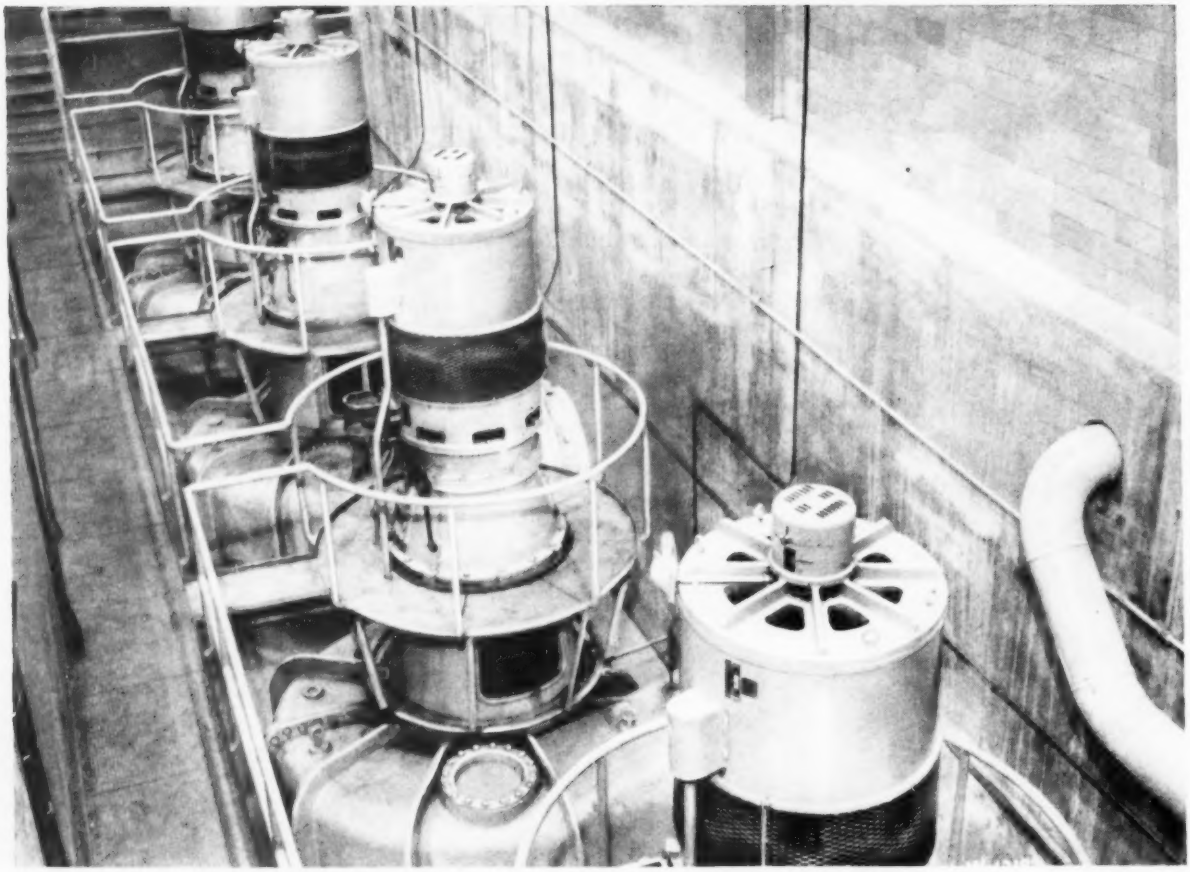
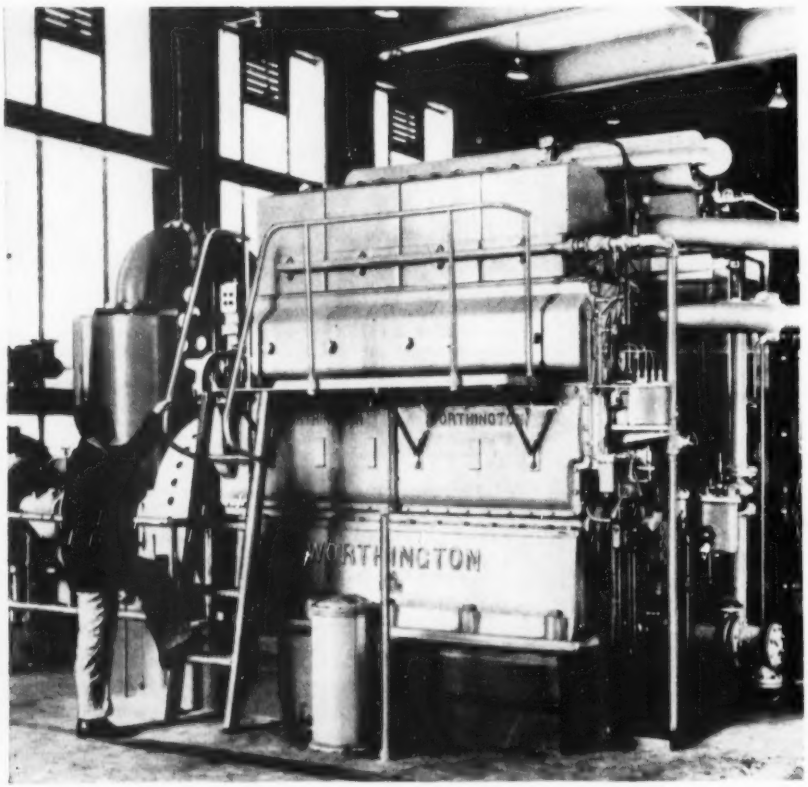
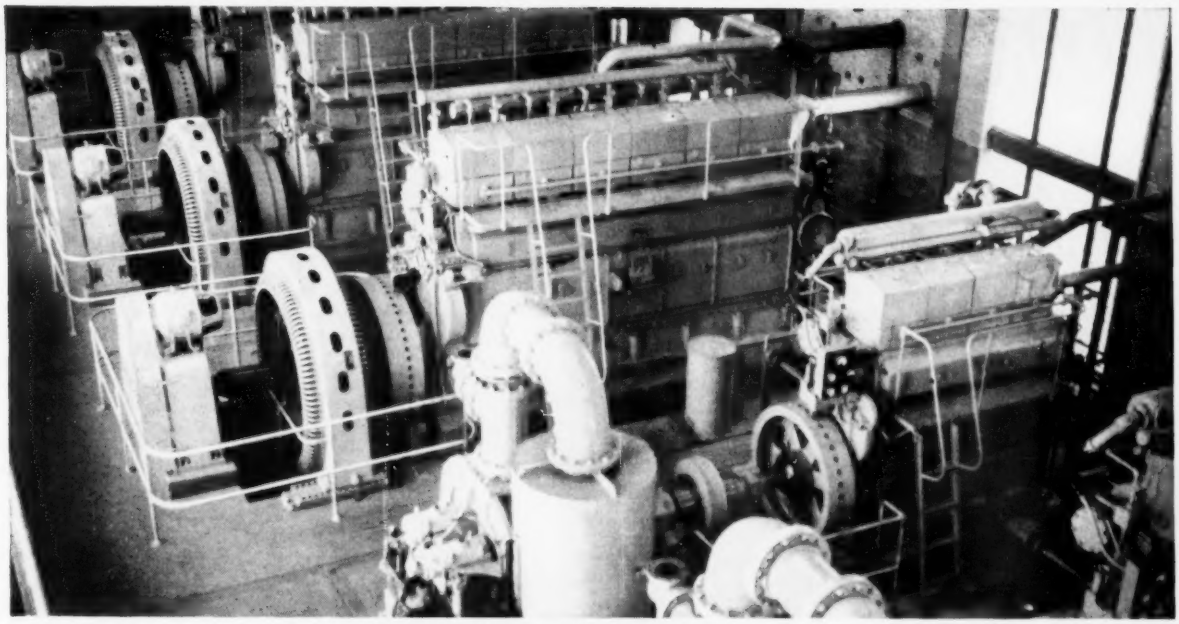


FOUR OF THESE WORTHINGTON MIXFLO PUMPS, each with a capacity of 83 million gallons per day, move sewage through various stages of its treatment at Boston's Nut Island Plant. The pumps are designed to operate at variable speeds through the use of the magnetic drive which in connection with Worthington float control will maintain a pump-well level of not more than 3 inches above or below normal—even though pumping rates vary between 35 and 300 mgd.



PRESENTLY USING SEWAGE GAS AS FUEL, these Worthington dual fuel engines are designed to operate on either gas or oil. They will maintain load in the event of a sudden emergency loss of gas supply by automatically switching to oil. Two of these 215-hp units drive the sewage aeration blowers at Boston's new sewage treatment plant at Nut Island



DUAL FUEL ENGINES AUTOMATICALLY MAINTAIN LOAD in the event of a sudden emergency loss of gas supply. These two 820-hp dual fuel engines and one 830-hp spark ignition gas engine drive three Electric Machinery generators. Two 215-hp dual fuel engines in the foreground drive positive displacement blowers.

Worthington equipment at Nut Island Plant helps Boston reclaim Quincy Bay beaches

Mixflo pumps have maximum capacity of more than 300 mgd of sewage

The new $10,000,000 Nut Island Plant at Quincy, Mass., is now treating 95 mgd of raw sewage which was previously pumped directly into Quincy Bay.

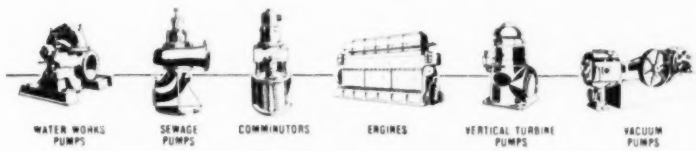
Four large Worthington Mixflo pumps, with Electric Machinery motor and magnetic drive, each with a capacity of 83 mgd, give this modern sewage treatment plant a reserve potential to meet any future demands.

Three large Worthington dual fuel engines drive the Electric Machinery generators which power the entire plant. Two smaller Worthington dual fuel engines drive the blowers for aeration of the sewage.

In addition to its larger pumps and engines shown here, Worthington also supplies comminutors, smaller sewage pumps, sludge removal pumps, and vertical turbine pumps for the water and sewage field.

Write us for a list of Worthington installations in your area, and complete information on how Worthington equipment can solve your sewerage problem. Worthington Corporation, Public Works Division, Section W.3.1, Harrison, N. J.

W.3.1



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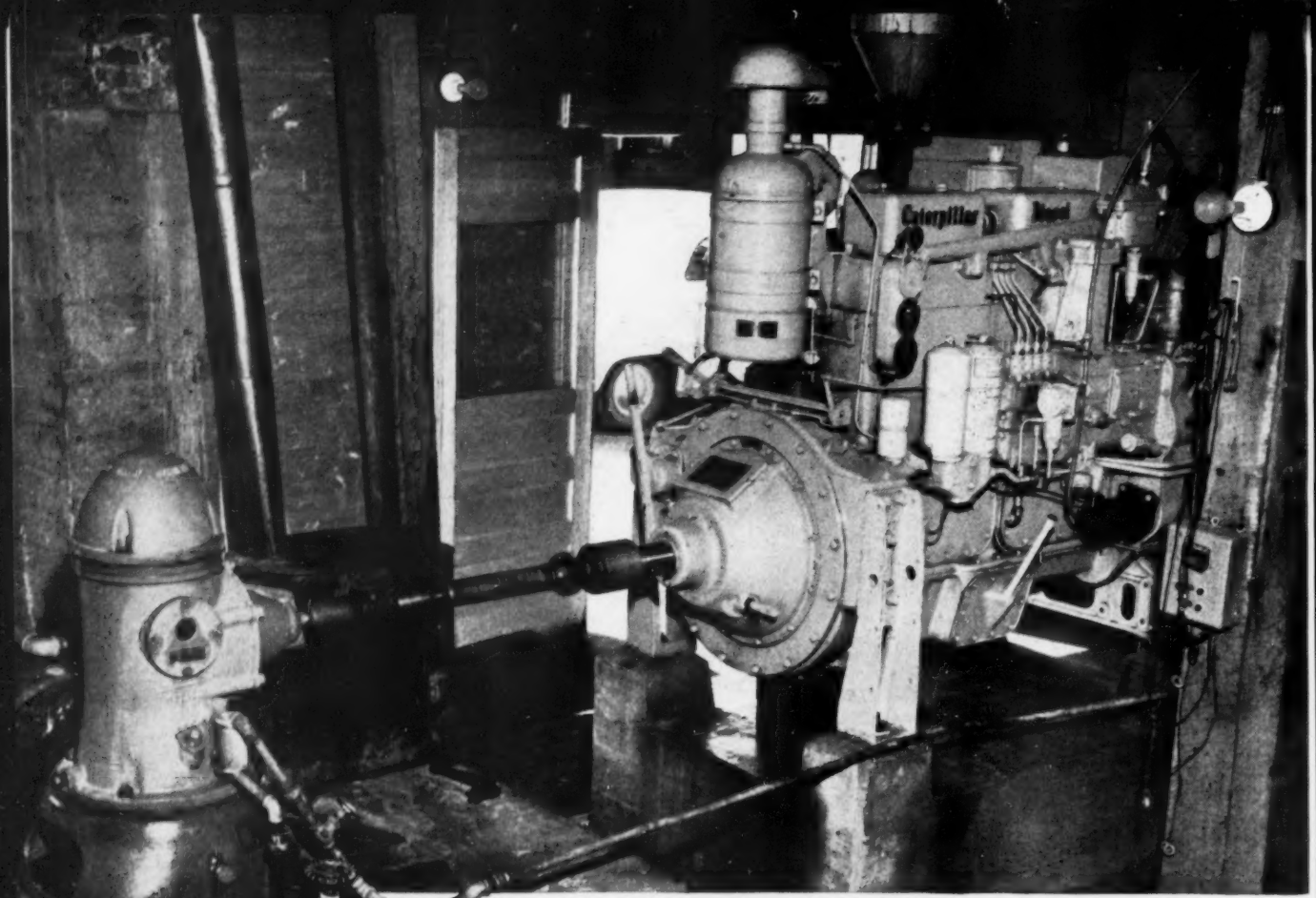

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PUBLIC WORKS

VOLUME 84, NO. 9
SEPTEMBER, 1953

Data on the Industrial Waste Problems of Cities

TO determine the extent of the industrial waste problem as it affects sewage treatment by cities, the Editors of PUBLIC WORKS recently asked a number of cities the following three questions:

Is the disposal or treatment of liquid industrial wastes a problem in your City? . . . About how many industrial plants in your City produce wastes that require treatment? . . . About how many of these may be required to pretreat their waste before discharge into City sewers?

The first group of questionnaires returned totalled 618, with 462 cities replying to one or more of the above questions. Difficulties with industrial wastes were reported by 100 cities in 30 states, with nearly 500 industrial plants producing wastes that ought to be pretreated before discharge into city sewerage systems. No information was asked in respect to the character of the wastes or the type of pretreatment that might be needed.

It should be remembered that the replies listed here represent the opinions of the local engineer and may not agree with industry, state, regional or Federal opinions.

Replies are continuing to come in and probably some six hundred additional will be received. It is felt that the data presented here by these cities highlight the problem of industrial wastes and may indicate one method of attacking it. Consulting engineers and manufacturers of sanitary engineering equipment can be of great help in providing services and equipment for solving this problem, supplementing the efforts of state sanitary engineering departments, the Public Health Service and regional stream pollution control associations. As we see it, the problem is to abate this pollution, and it does not matter greatly by whom it is done.

In the table herewith are presented information on those cities which have reported the necessity for pretreatment, or have otherwise indicated that they have a problem. Separately are listed those cities which report that, at this time, no immediate problem in respect to such industrial wastes exist.

Table 1—Cities Reporting Industrial Waste Problems

	Number of Waste Producers	Number Requiring Pretreatment
Alabama		
Mobile	10	10
California		
Barstow	1	1
Burbank	300	85
Chico	5 or 6	All
Corona	1	1
Inglewood	20	5
Modesto	20	10
Oceanside	25	5
Pomona	10	All
Shafter	32	All
Visalia	4	1
Connecticut		
Derby	12	7
Norwich	6	All
Florida		
Dania	3	3
Winter Garden	4	4
Illinois		
Aurora	. . .	2
Woodstock	3	1
Indiana		
Anderson	6	All
Columbus	5	2
Crawfordsville	1	1
Kokomo	6	All
New Castle	3	1
Iowa		
Cedar Rapids	. . .	1
Dubuque	1	??
Keokuk	. . .	1
Sibley	1	??
Storm Lake	4	None
Kansas		
Iola	2	1

More tabular data on next page

Table 1 (Cont.)—Cities Reporting Industrial Waste Problems

Kansas City	25	25
Marysville	2	2
Maine		
Augusta	3	1
Massachusetts		
Ayer	1	1
Ipswich	1 or 2	1 or 2
Peabody	8	All
Michigan		
Big Rapids	1	1
Fremont	2	2
Jackson	25	6
Lansing	12	5
Niles	2	2
Zeeland	3	1
Minnesota		
Albert Lea	1	1
Fairmont	2	2
International Falls	1	1
Owatonna	3	1
Wells	...	1
Winona	3	3
Missouri		
Dexter	2	1
Joplin	5	4
Kennett	1	1
Montana		
Glendive	1	1
Sidney	1	1
New Jersey		
Bridgeton	5	??
New York		
Falconer	3	3
Ithaca	4	2
Sidney	1	1
North Carolina		
Albemarle	3	2
Concord	1	1
Laurinburg	1	1
Mooresville	2	2
Raleigh	3	2
Roxboro	3	3
Ohio		
Bedford	3	3
Delaware	4	1
Fostoria	4 or 5	3
Hamilton	10	5
Ironton	3	3
Lancaster	...	1
Lorain	1	1
Norwalk	2	1
Orrville	6	3
Ravenna	25	1
St. Marys	6	4
Oklahoma		
Sulphur	1	1
Oregon		
Coos Bay	1	1
Newberg	1	1
Pennsylvania		
Altoona	1 or 2	1 or 2
Bradford	4	4
Coatesville	1	1
Corry	5	5
Philadelphia	600	24
Pottstown	8	8
Quakertown	4	4
Williamsport	9	4
Rhode Island		
Woonsocket	...	5
South Carolina		
Greenwood	7	1
Orangeburg	1	1
Tennessee		
Elizabethton	2	2
Texas		
Yoakum	2	2
Vermont		
Barre	70	All
Virginia		
Hopewell	4	4
Washington		
Yakima	12	12
Wisconsin		
Baraboo	3	2
Eau Claire	3	3
Fort Atkinson	5	2
Marinette	1	1
Ripon	5	2

Cities Reporting "No Problem"

Alabama -- Sheffield, none; Opelika, 5 plants, no problem. *Arizona*—Mesa, no problem. *Arkansas*—Batesville and Hope, no problem, Fayetteville 3 plants, no problem. *California*—No problem: Antioch, Arcadia, Benicia, Blythe, Burlingame, Coronado, Escondido, Gardena, Hanford, Los Banos, Los Gatos, Merced, Mountain View, Nevada City, Red Bluff, South Gate, South San Francisco, Susanville and Whittier. No problem: Azusa, 20 plants; Davis 3 or 4 plants; La Habra 1 plant; Manteca 3 plants; Martinez 2 plants; Salinas some problem; and Yuba 2 plants. Monrovia, data unavailable.

Colorado—Colorado Springs and Delta no problems; Montrose, data lacking. *Connecticut*—Ansonia, one plant, not discharging; Bristol, some problems. No problem: Darien, Farmington, New London, and Windsor. *Delaware*—Newark 4 plants, no problem; Wilmington awaiting experiences with new treatment plant. *Florida*—No problems: Dade City, Gainesville, Green Cove Springs, Hollywood, North Bay Village, Pompano Beach, South Miami, Vero Beach and Winter Park. West Palm Beach reports an industrial waste problem but no pretreatment required. *Georgia*—Cordele, Manchester and Jessup, no problems. *Idaho*—Coeur D'Alene, Orofino and Weiser, no problem.

Illinois—No problems: Belleville, Champaign, Des Plaines, Downers Grove, East Moline, Evanston, Flora, Galena, Glencoe, Lake Forest, Lowpoint, Oak Park, Pekin, Riverside, Urbana, Western Springs, Wilmette and Winnetka. Some problem and one plant in Anna; one plant, no pretreatment problem in Canton; two plants, no pretreatment required in Joliet; one plant and no pretreatment problem in Oglesby and the same in Paris; Maywood, data not available. *Indiana*—No problem: Highland and Huntingburg. *Iowa*—No problems: Centerville, Clarinda, Clinton, Fort Madison and Grinnell. Clear Lake, three small industries no pretreatment problem; Fort Dodge, data not available.

Kansas—No problem: Abilene, Augusta, Clay Center, Holton, Humboldt, Manhattan, Marion, Newton, Pittsburg and Pratt. Concordia, 3 plants but no problems; McPherson three plants, no problems; Winfield two plants, no problems.

Kentucky—No problem: Danville, Dayton, Ft. Thomas, Nicholasville, Owensboro and Versailles. *Louisiana*: Alexandria, no problem. *Maine*: No problem and no plants requiring pretreatment in: Auburn, Belfast, Berwick, Bridgton, Brunswick, Chelsea, Farmington, Houlton, Islesboro, Madison, Milbridge, Old Town, Oxford, Portland, Stonington, Waldoboro and Waterville.

Maryland: No problem: Frederick and Greenbelt. *Massachusetts*: No problem: Andover, Brockton, Brookline, Danvers, Foxboro, Holden, Hudson, Lexington, Lynn, Middleboro, Natick, Newton, Saugus, Shirley, Stoneham, Waltham and Wakefield. *Michigan*: No problem: Berkley, Bessemer, Buchanan, Cheboygan, Durand, Hazel Park, Manistee, Mason, Midland, Petoskey, Pontiac (6 industries, no trouble so far), Rogers City, South Haven, Traverse City and Vassar. St. Joseph has a problem which is now under study. Zeeland has three plants, one of which has been asked to provide pretreatment.

Minnesota: Caledonia (some problem); no problem: Canby, Columbia Heights, Crookston, Hopkins, Minneapolis, Rochester, St. Peter, Sleepy Eye and Springfield. *Mississippi*: No problem: Greenwood, Hattiesburg, Meridian, Natchez, Oxford and Tupelo. *Missouri*: No problem: Berkeley, Hannibal, Jennings, Mexico, Rolla, St. Joseph (but may be soon) and Washington. *Montana*: No problem in Laurel and Missoula.

Nebraska: No problem: Columbus,

(Continued on page 145)

Sewage Treatment Plant for STEEL MILL WASTES

Reduction of phenols and treatment of domestic sewage in combination with other steel mill wastes were design problems

DANIEL M. VAIL,

Project Engineer, A. J. Boynton & Co.

COINCIDENT with the construction of a new open hearth plant and steel pipe mill by the Lone Star Steel Co., of Dallas, Tex., it was necessary to provide water filtration and sewage treatment facilities. The sewage treatment plant described here is located at Lone Star, Morris County, Texas. It was designed by A. J. Boynton and Company, Consulting Engineers of Chicago and Dallas and Brown and Root of Houston were the contractors.

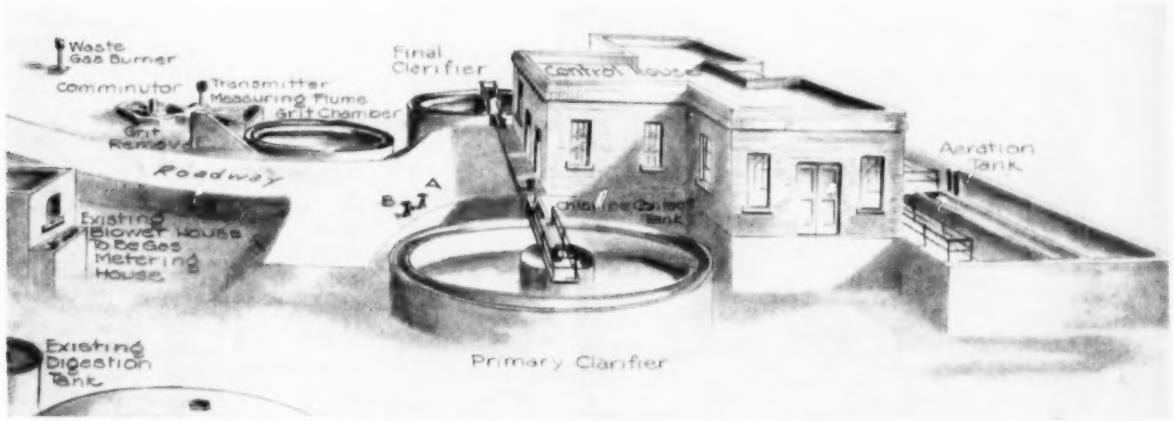
The sewage plant will treat wastes from the municipality of Lone Star and the sanitary and industrial wastes from the mill. Final plant operations contributing wastes to the sewage treatment works will consist of blast furnace, coke ovens, by-products plant, cast iron foundry and the newly constructed steel mill.

Prior to design, it was realized that phenol wastes from the coke oven by-products plant would be a substantial governing factor. European, English, and American methods and results were studied. Biological filters produce good results on the Continent, whereas activated sludge is the more common practice in the United States. The operations and records of plant-scale treatment of combined sanitary and phenolic wastes at Gary, Indiana, were studied, together with results obtained by the Dow Chemical Company. From this review, activated sludge showed the most promise.

Preliminary drawings covering a conventional activated sludge plant had been made when the possibilities of considerable savings from the use of the newer biosorption process became evident. As originally designed, the plant would treat the immediate flow of sewage from the steel mill and the municipality; future growth would require sewage plant expansion. By utilization of the biosorption process, however, the initial plant might be ample for the future. Through cooperation of the Texas State Department of Health, the Austin sewage treatment plant was visited and results studied.

Laboratory work indicated biosorption to be superior in reducing phenols. The rate of removal appears to be dependent upon whether or not the sludge has had previous contact with phenol and the state of nutrition of the sludge. Adapted sludge with a suspended solids concentration of 3,000 to 3,500 ppm reduced 2 ppm phenol in 5 to 10 minutes; 10 ppm in 20 to 30 minutes; and 50 ppm in 130 minutes or less, depending upon the state of nutrition of the sludge.

Following the study and laboratory work, it was decided that both tried and experimental methods should be incorporated in a single plant. An activated sludge plant was designed as the basic process, using present estimated sewage flows as a guide but with a piping and valving arrangement for conversion to bio-

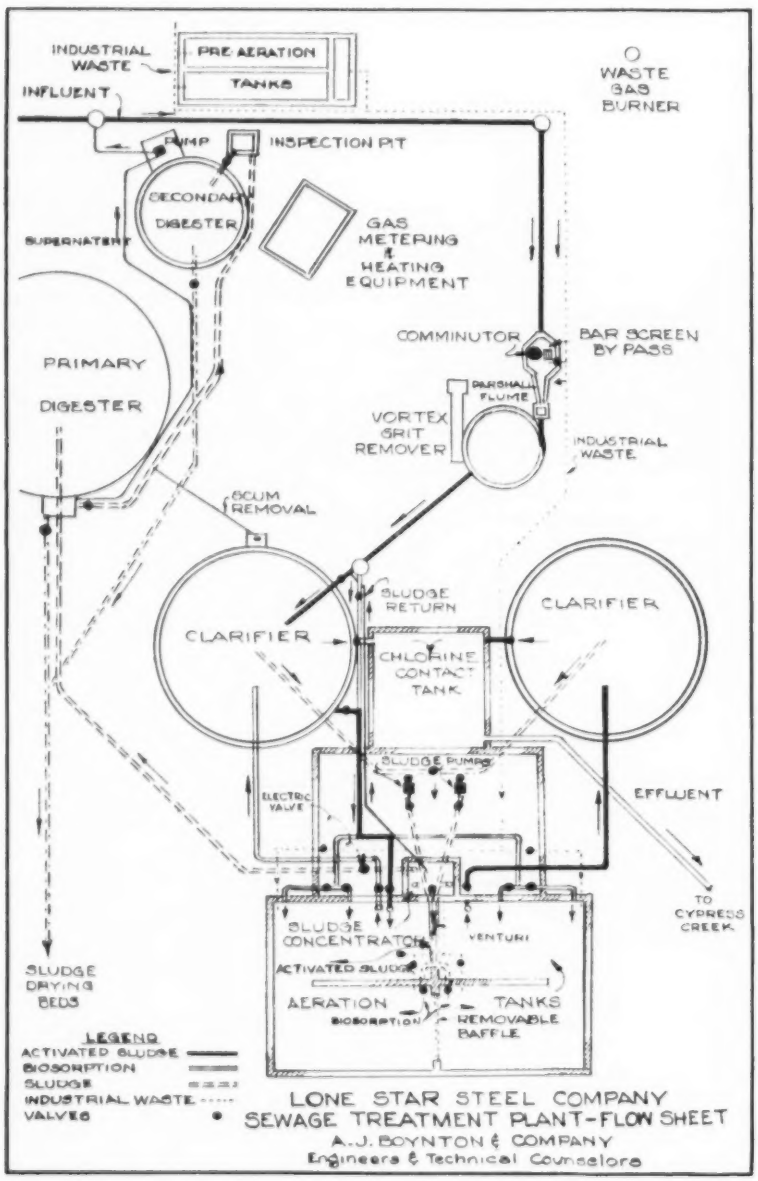


● **LAYOUT OF PLANT** to treat a combination of wastes from open hearth plant and steel pipe mill plus domestic sewage.

sorption. Actual plant water consumption and sewage discharge were measured. During daytime comparative periods for a plant population totaling 1,080, the water consumption averaged 93.75 gallons per minute and sewage discharge 95.8 gpm, indicating a very small amount of infiltration. Projecting these discharges to a future employment of 2,500 workers and a probable municipal population of 2,000, domestic sewage discharge was estimated at 414,200 gallons per day. Adding a computed industrial waste of 43,250 gallons, the total design sewage flow amounted to 457,450 gallons per day.

As now laid out for activated sludge, the plant provides primary and final settling of 2½ hours each, with an aeration period of about 10 hours. These detention periods are more than adequate for present sewage treatment, but would be inadequate in the foreseeable future. Based on biosorption, a total sludge conditioning period plus activation with sewage of 5 hours is provided. This is followed by 2½ hours sedimentation. The biosorption figures show use of but one-half of the plant, with the remaining half retained for the future.

The plant as now laid out consists of a Chicago comminutor placed in the influent channel with a bypass bar screen, followed by a Parshall flume for measurement of sewage flow. This flume discharges into an Infilco vortex grit remover. Primary and final clarifiers have Infilco equipment and the aeration tanks have Colaflex diffusers. Chicago Pump Company supplied the sludge pumps and Roots-Connersville the blowers. Wallace and Tiernan chlorination equipment is installed.



LONE STAR STEEL COMPANY
SEWAGE TREATMENT PLANT-FLOW SHEET
A. J. BOYNTON & COMPANY
Engineers & Technical Counselors

Using activated sludge, the sewage flows through the comminutor and Parshall flume into the grit chamber. After grit removal, the sewage is discharged to a primary settling tank from which it enters the aeration tank. Following aeration, the treated sewage discharges to the final settling tank and into a chlorine contact tank. The chlorinated effluent flows into Big Cypress Creek, a tributary of the Red River.

In the biosorption process, the sewage will flow from the grit chamber to the mixing or aeration tank and thence to one of the clarifiers.

Considerable flexibility of operation is provided. Following grit removal, the sewage may be discharged to either clarifier or aeration tank. Return sludge may be discharged at different points depending on the process or the aeration time required. Sewage may enter the aeration tank at any one of several places, providing varied periods of sludge conditioning or sludge-sewage aeration. Adjustable weirs are provided for the clarifiers.

Sludge may be pumped from either or both clarifiers to the aeration tank, with excess sludge entering a concentration chamber. Venturi metering of the sludge is provided. Recorders for sewage flow and sludge flow are located in the office. Immediate and continued determination of sludge return percentage may therefore be visualized. From the concentration tank, sludge flows by gravity to the primary digestion tank. This sludge flow is electrically regulated. The primary digester is equipped with Infilco circulation equipment. After primary digestion, the sludge may be discharged either to drying beds or to a small secondary digestion tank equipped with a floating cover. Supernatant liquor may be pumped from either or both tanks to the plant influent. Gas will be collected and used for heating the tanks, with surplus gas being burned.

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industrial wastes, using
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several p aeration tank.

KEEPING STREETS CLEAR IN WINTER

Snow Plowing, Snow Removal and Ice Control

GEORGE M. SHEPARD, Chief Engineer, Department of Public Works, St. Paul, Minn.

IN order to keep traffic moving safely, or even at times moving at all, snow must be plowed promptly from pavement and roadway surfaces. For a considerable mileage of streets it must be loaded, hauled away and disposed of. The formation of ice must be prevented or controlled. These comprise a major operation comparable in importance as a municipal activity to street cleaning and street maintenance. The trained personnel and much of the equipment used in street cleaning and street maintenance form the basis of our snow removal organization. The truck drivers and machine operators know the streets and are familiar with difficulties resulting from special topographic or traffic conditions. Sanding crews know the trouble spots when streets become icy from sleet or snow.

The basic snow organization must be ready to go into action on a few hours notice. These crews during the emergency work caused by heavy snowfalls can be expanded by men and equipment from construction contractors or by trucks from truck owners. In years of relatively light snow, the regular city forces can handle the job with little outside help. Budgets should be based upon the cost of maintaining the basic organization for an average snowfall year. Expenditures required in excess of this for heavy snowfalls should be taken care of by emergency appropriations. At present the greater portion of snow operations is covered by so-called emergency appropriations.

Snowfall during the past 13 years has varied from 19.3 to 80.4 ins., with a long term mean of 40.5 ins. Although there have been a few heavy snow storms early in November, the average snow plowing and removal season is from November 15th to April 1st. The ordinary heavy snow is about 7 or 8 ins. Light snows of 2 or 3 ins. do not require plowing unless there are several such storms in succession but they soon consolidate into ice and require prompt attention.

● **ATHEY force feed loader collecting and loading snow into truck for disposition. Snow dump at left. Dump is used where conveniently located space exists.**

The work to be done includes the three principal items of snow plowing, snow removal and ice control. Streets must be plowed as soon as the snow falls. In business districts and on some of the narrower heavy traffic streets, the accumulated snow must be loaded, hauled away and disposed of. To avoid icy conditions the snow must be plowed as close to the street surface as possible. Where the snow follows sleet or rain there is often a frozen covering which can be removed only with difficulty and which must be treated with abrasives at intersections, grades and other critical locations. Due to the terrain there are probably more streets in St. Paul with grades than in most midwestern cities. Streets must be plowed to the full curbed or graded width which varies from the 30 and 32-ft. residential streets to the 95-ft. roadway width on University Avenue.

The list of city owned equipment given in Table 1 is available for snow operations. During the past year there has been added one SnoGo, one Sicard, 2 Athey and 2 Hough loaders to take the place of old equipment and to provide for

the increased volume of work. The straight blade plows are mounted on trucks, flushers and oilers. The "V" plows are mounted on 4-wheel drive trucks, on tractors or motor graders. City owned equipment is, where necessary, supplemented by rental equipment. Specialized equipment suitable for snow plowing or removal is becoming more available from private contractors. Motor graders, front end loaders and similar equipment can usually be rented in winter. Private trucks are hired throughout the snow removal season from Civil Service lists. These trucks are known as "Truck, owner-driver"; the rates are fixed for each truck size based upon the furnishing of truck, driver, repairs, fuel and oil.

All maintenance of city equipment is performed under the direction of the Superintendent of Municipal Equipment and by the regular staff of mechanics. While the plows remain mounted throughout the season on flushers or oilers, they are removed from trucks when the trucks are required for other use and remounted at the next snow storm. The under-carriage for the plow is placed on the truck in the fall. After this, for each storm about one-half hour is required per truck to mount the plow and put on the chains, two men being used for each job. On account of variability in make of plow and the under carriage, the plows are stowed in a fixed order when removed. For remounting each truck reports in corresponding order so as to pick up its plow. Ballast is required in the trucks to give weight and stability during plowing operations. The principal item of maintenance of snow plows is the replacing of cutting edges, the frequency of replacement depending on the use. We have found that mild steel is most satisfactory for this purpose. In the spring the plows after removal from trucks and other equipment, are cleaned, repaired and painted ready for the next season.

Snow operations are under the direction of the Commissioner of Public Works, with the work under the immediate supervision of the Superintendent of Sanitation. The center of operations is the "snow office" located at the Municipal Equipment building. Close contact is maintained with the local U. S. Weather Bureau so as to receive current information as to oncoming storms and changes in the nature of snow storms. For snow plowing the city is divided into districts as hereinafter described. For ice control the city is divided roughly into eleven districts, each of which is under the direction of the regular ward foreman, with the loop, a separate area, under a district foreman. During snow plowing, contact with equipment is maintained by telephone from the operator and by ward foremen.

● SNO-GO plow removing and loading snow into trucks for hauling to dump. Business district is completely cleared.

● SICARD SNOWMASTER mounted on Austin-Western 99 motor grader removing and dispersing snow from highway.

TABLE 1.—SNOW PLOWING AND REMOVAL EQUIPMENT

Tractors with bulldozers	2
Oil Distributors	5
Oil Nurse Tanks with Plows	2
Dump Trucks—3 ton	30
4-Wheel Drive truck V and Wing Plow	2
Street Flushers	3
Industrial Tractors with blade	3
Motor Graders	13
Sicard Snowmaster	1
Sno-Go	4
Athey Loaders (2 with side loader)	5
Hough Front End Loaders	4
Lull Loader on Case Tractor	1
Snow Plows (mostly one-way)	43

EQUIPMENT RENTED when available

- Motor Graders
- Trucks with Plows
- Trucks
- Tractors with bulldozers

Snow Plowing

There are about 773 miles of improved streets in St. Paul which must be plowed. This mileage is divided into 280 miles of primary plowing routes, 24 miles of loop streets, and 469 miles of residential area plowing routes. The primary routes include 25 sections divided so that each section can ordinarily be completed by the equipment assigned to it within a 12-hour shift. The primary routes take in the important traffic thoroughfares and such other streets as will give a plowed network of streets not over one-half mile apart. Attention is concentrated on the early completion of plowing of the primary routes, although if the storm is not too severe some work may be done during the first 12-hour shift on the residential routes.

As snow plows are dispatched from the equipment yard each operator is furnished with a typewrit-

TABLE 2.—COST OF SNOW PLOWING, SNOW REMOVAL AND ICE CONTROL

Year	Snow Plowing	Snow Removal	Ice Control	Grand Total
1940	$39,137.40	$72,268.67	$51,135.58	$162,541.92
1946	24,838.03	77,105.81	87,263.21	189,207.05
1949	32,737.60	157,901.06	89,920.90	280,549.56
1951	89,051.49	309,866.57	144,102.75	543,020.81
1952	167,847.10	374,257.85	206,859.22	748,964.17

dential routes the operator is given a map showing streets within the area he is scheduled to plow, but he has some leeway as to the order of carrying out the work. Suitable equipment is assigned to take care of any special conditions in these areas. As an example, on heavy grades a slow motor grader is more suitable for plowing than a truck mounted plow which must maintain a certain speed to be effective. For the ordinary heavy storm of 7 or 8 ins., the residential routes generally require two operating shifts. Following the completion of the pri-

● **CATERPILLAR** motor grader piling snow into windrow preparatory to loading trucks for final disposal.

● **AUTOMOBILES** parked in the snow removal area are towed away prior to the operation of snow removal equipment.

ten schedule of streets to be plowed. For the primary routes a pre-determined fixed order of plowing is required. Straight runs are used as much as possible to avoid lost time at turns. Each plow is manned by an operator and a helper. Operators are required to report their progress by telephone at intervals. The installation and operation of a two-way short wave radio system, at least on city equipment, permitting direct communication from operator to the central dispatching office, would facilitate operations and save the time required to make use of public or private telephones along the routes. Plowing on the primary routes is ordinarily begun as soon as the snowfall reaches about 4 ins., although the beginning may be deferred at times until after periods of heavy traffic movement. In the central business district it is practically impossible to do much plowing or snow removal until after 10:00 P.M. The snow is plowed as close to the pavement or street surface as possible, plows being set to clear at about 1 in. A self-tripping device saves the plow from damage due to obstructions.

For the larger mileage of residential routes the entire time required for complete plowing, allowing for rest periods, is about 48 hours. *(Turn to page 141)*

TABLE 3.—WAGE AND EQUIPMENT RENTAL RATES

Item	1940	1946	1949	1951	1952	1953
Laborer	.55	1.01	1.45	1.52	1.67	1.82
Foreman, Utility	.82¾	1.09½	1.65	2.05	2.36¾	2.43¼
Power Shovel Operator	1.50	1.70	2.00	2.27	2.45	2.72
Road Machine Operator	.73	.98¼	1.42	1.64	1.79	1.94
Truck Driver	.69½	1.00	1.42	1.64	1.79	1.94
Truck Owner Driver—1½-Ton	1.50	1.75	2.15	2.72	2.87	3.12
Truck Owner Driver—3-Ton	2.30	2.30	2.65	3.42	3.57	3.82
Truck Owner Driver—5-Ton	3.00	3.40	3.70	3.72	3.87	4.12
Equipment						
1½-Ton Truck	.75	.90	1.00	1.20	1.20	1.20
3-Ton Truck	.90	1.20	1.25	1.50	1.50	1.50
5-Ton Truck	1.20	1.50	1.75	1.90	1.90	1.90
Diesel Motor Grader	4.00	4.50	5.50	5.50	5.50	5.50
Power Shovel	5.00	7.50	10.00	10.00	7.50	7.50

Equipment rates are set up for city equipment and includes maintenance and depreciation.

DETAILS

OF TWO FAR NORTH WATER SYSTEMS

A contribution by Stanley S. Copp, M.S., sanitary engineer, Department of National Health and Welfare of Canada, Edmonton, Alberta, in Public Health Reports, Public Health Service.

WATER works engineers in Northern Canada and Alaska are faced with unique design and maintenance problems. Preventing the freezing of water and sewer lines is paramount in design in northern climates. It is a factor which raises both construction and operating costs many times higher than those in more temperate regions. Two all-weather underground water supply systems installed within the last few years in the Northwest Territories of Canada illustrate many design and operating problems.

One system is at Yellowknife, where the mean annual temperature is 22° F., and the top of the permafrost is 10 feet or less from the surface of the ground. Annual precipitation is 10 inches, and snowfall is sparse. Water is pumped from a bay, chlorinated, heated, and circulated through a grid system 3,500 feet from the pumphouse. Part of the water is returned to the pumphouse for reheating and recirculating.

Each main and house connection has a return line beside it. Water lines are of cast iron pipe, laid at 5 feet 6 inches minimum cover and to grade for drainage. Both 6-inch supply and 4-inch return mains, which are side by side, are insulated with approximately 1 foot of compacted moss on the top and sides and from 0 to 2 inches underneath. Extremely fine sand with granite outcroppings covers the area.

Meters and recording thermometers are located on discharge and return water lines in the pumphouse, and thermometer wells are located in the mains at the manholes. The water is heated from November through May. Originally installed in the pumphouse were two 60-hp. and one 80-hp. return tubular boilers, but one firebox and diffuser has been reduced to give roughly 15 hp. capacity. Under normal conditions, two ¾-inch copper lines are used for heating the water, one injecting into the recirculation line and one into the intake well. Outgoing water from the pumphouse is maintained at about 41° F. During March, when 80 percent of the outgoing water is recirculated, the temperature of the return water is about 40° F. On June 30, 1952, 1 month after heating was discontinued, the discharge temperature was 50° F., and temperature of the return water was 46° F.

Of the 37 fire hydrants, all of the dry barrel type, on the grid system, 8 froze last year. The most serious freezing occurs when circulation fails and the bottom of the hydrant freezes, but this happens infrequently. Caps and spindles at the top and at the drain opening at the bottom freeze often. Above-ground freeze-ups are thawed with blow torches; those below ground, by placing a fire pot in the manhole box overnight. Alcohol antifreeze is applied to caps, packing, and so forth, and hydrants are checked twice a week.

Five major breaks caused by frost action in the winter of 1952 were repaired without interruption of service. Excavation of breaks with jackhammers takes about 2 weeks per hole because of the hardness of the frozen ground. Bits are dulled and broken at about the same rate as in breaking concrete. Powder cannot be used because of the proximity of pipes, and holes cannot be backfilled until the frost is gone. Any interruption of service longer than one-half hour results in freeze-ups. None of the 142 service connections located at an average depth of 5 feet was frozen under normal operating conditions.

About 175 miles farther south at Fort Smith is a system which preheats the water and utilizes bleeders at dead ends. The settlement has a mean annual temperature of 25° F. The soil is a fine sand.

Two intakes drilled horizontally through 40 feet of solid rock into rapids on the Slave River supply water to pumps on the edge of the river. From there, the water is pumped to a treatment plant on the top of the bank. Alum and soda ash are added, and the water is spirally mixed upward, settled, filtered, chlorinated, and stored in a reservoir under the plant. The treated water is then heated and pumped through a pressure tank to the distribution system.

Transite pipe is used for the distribution system, which is laid at an average depth of 10 feet and a minimum depth of 8 feet. Minimum depth for house connections was specified for 8 feet, but some are laid at only 6 feet and are frozen several times during the cold weather.

The temperature of the river water varies from 32.8° to 65° F. In January, water leaving the plant at 42° F. is cooled to 35° F. at the end of the system. On April 7, 1952, the 4-inch main at the end of the system froze, disrupting two services. The frost penetrated 14 feet at this point. The two intakes from the river froze, and a gasoline pump had to be used to pump water over the ice to the wet well. Several house connections were frozen for a short period, two for more than a day.

Permafrost, which reaches nearly to the surface at Yellowknife, is not the insurmountable obstacle it was once considered to be. It is hoped that these two experiences may lead to less costly design which will permit other supplies to be installed and operating expenditures lowered.

• • •

Accidents in a Water Department

Of the agencies involved in accidents in the Detroit, Mich., Water Department, hand tools, materials and working surfaces accounted for more than two-thirds of the total. In more than half of the accidents, employees were either (1) pushing, pulling or striking; or (2) lifting, lowering or carrying. The Department reported 298 injuries in the past fiscal year, with an average cost per injury of $30.73.

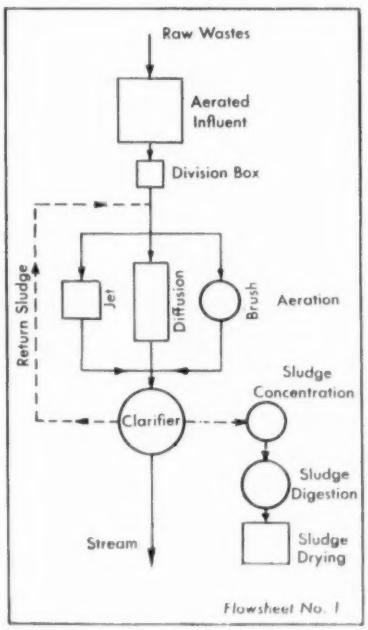
ACTIVATED SLUDGE APPLICATION TO INDUSTRIAL WASTE TREATMENT

EDMUND B. BESSELIEVRE,
MASCE, Chief Sanitary Engineer, International Sales, The Dorr Co.

UNLIKE domestic sewage, which always consists of the same basic elements, industrial wastes differ materially in composition. They seldom contain the same proportions of polluting elements, nor are they of the same character or susceptible to precisely the same methods of treatment. Thus disposal methods for industrial waste cannot always be based solely on economic and practical considerations. They offer other problems, also. Industrial plants are often located in built-up or congested districts, where large ground areas are not available for waste treatment plants; or the character of the neighborhood may be such as to require all treatment operations to be under cover. Because of the nature of the activated sludge process, many of these limitations can be overcome, and every industrial waste which can be treated satisfactorily by biological methods is a candidate for treatment by activated sludge.

In this article it will be the purpose to list those classes of wastes for which activated sludge has been found to be effective and to give data showing the factors which may contribute to the proper design for such wastes. These data, such as hours of detention in aeration tanks, amount of air required, and detention in sedimentation tanks, are from published descriptions. For most of these references are supplied. It is impossible to present data on all wastes, for many of them have not been sufficiently through the mill of experience to provide reliable design information.

In some cases the data presented may indicate that rather long aeration periods are required. These should not lead to the conclusion that the activated sludge process would not be economical, for the volume of industrial wastes which require treatment are usually relatively small in volume, and tank sizes and areas will not be unreasonably large, even though detention periods may run to 24 to 40 hours, or even more.



● **SOME methods of aeration for milk products wastes treatment.**

Wastes Adaptable to Treatment

Milk Product Wastes. — This class of wastes includes those from milk separating stations, butter and cheese plants, powdered milk plants, and other establishments which receive milk and process it in any way.

The literature of activated sludge treatment of milk and milk products is voluminous and there is very definite evidence that this class of waste may be satisfactorily treated, whether for pre-treatment previous to the discharge of the wastes into a city sewer system, or for complete treatment for discharge into a stream. Not only has the treatment of milk wastes been satisfactory in the United States with activated sludge, but in England also.

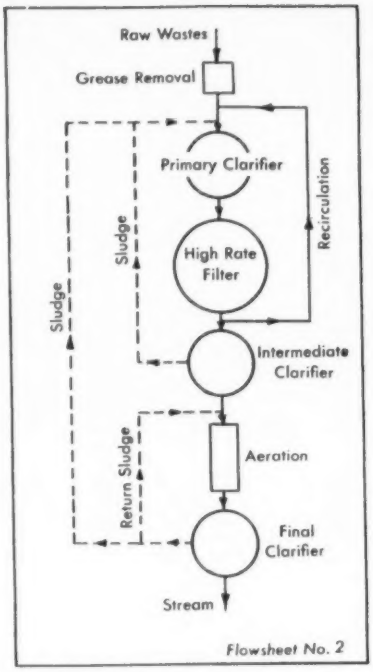
The treatment of these wastes, as shown by Flowsheet #1, may involve straight activated sludge treatment, with pre-aeration of the raw wastes to reduce the oxygen demand; or by the Bio-Activation process which involves a combina-

tion of high rate trickling filters and a step of aeration, which is shown in Flowsheet #2. The advantage of the Bio-Activation Process for this type of waste is that the trickling filter is capable of absorbing loads of high strengths or heavy concentrations of wastes, and even those which are slightly septic, without trouble. Thus, this method uses the high rate trickling filter to smooth out variations in flow and strength, and the aeration step to polish the effluent and achieve the final BOD reduction economically.

As milk products wastes are apt to come in slugs, it is advisable to provide a concentration tank to smooth out the flow over a period of hours for a more uniform consistency and loading.

Rudolfs[1] characterizes the activated sludge process for milk wastes in the following definite statement: "This process can be successfully used for complete treatment of milk wastes. An adequately designed, well-operated plant of this type is not readily upset, nor is the control procedure too difficult for the personnel available at the milk plant. This process has lower construction costs and produces a better effluent than the biological filtration. The basic capacity of the aeration tank is about 80 gallons per pound of BOD. Air requirements are approximately 1 cubic foot per minute per pound of BOD per day. The mixed liquor has a suspended solids concentration of 5000-6000 ppm."

Antibiotics and Pharmaceutical Wastes. — The production of antibiotics — penicillin, aureomycin, streptomycin, etc.—produces wastes which though small in volume, are high in BOD and polluting elements. The laboratories which have concentrated on the manufacture of these "wonder drugs" have had to install complete treatment plants. As it was not known just what method was best, a period of experimentation was necessary before definite steps could be taken. This period is over now, and several of the leading antibiotic manufacturers have installed full scale plants. Among these are the Lederle Laboratories' plant at Pearl River, N. Y.; Calco Chemical Company's plant at Willow Island, West Virginia; and the Heyden Chemical Company's plant. Experimentation by the first two of these has resulted in the development and installation of full scale plants, combining activated sludge and trickling



Flowsheet No. 2

● **IN THIS flowsheet, trickling filters and activated sludge are combined.**

filters of the high rate type. While the periods of detention in the two plants differ slightly, the layout of units is practically identical and is shown in a composite Flowsheet #3. In the case of the Heyden Company plant, activated sludge alone was found to be satisfactory on the penicillin wastes and showed reductions in BOD of 80% with 24 hours aeration and 42.4% with 12 hours areration. It was the conclusion of the Heyden engineers that activated sludge with short period aeration is the most economical treatment for penicillin wastes if only partial treatment is required or when the final effluent is to be discharged to a municipal sewer or a large body of water.

Packing House and Slaughterhouse Wastes. — Experimentation on this class of wastes has been conducted for a number of years. The Chicago Sanitary District demonstrated that activated sludge treatment with 9 hours aeration and with 3.5 cubic feet of air per gallon in summer and 4.0 to 5.0 cf in winter, would reduce the initial BOD from 600 ppm to 50 ppm.

At the Kuhner Packing Company, Muncie, Indiana, activated sludge proved very satisfactory on a flow which varied from 200,000 to 500,000 gallons per day. This plant employed pre-aeration of the raw wastes, intermittent intensity of aeration in the main aeration tanks, with provisions for occasional aeration in the final sedimentation tank, with split flow or return sludge. Aeration time varied from 11.2 to 21.7 hrs.; 4.5 cf of air was applied per gallon and 780 cf per lb. of BOD reduced raw waste BOD was 708 and final 9.0 ppm.

In Holland, at Zaandam, Kessener brush aerators are used with 30 hours detention in the tanks, producing a satisfactory effluent.

Rudolfs[1] shows that activated sludge with provision for pre-aeration and sedimentation, with aeration of 17½ hours and with air of 4.5 cubic feet per gallon of wastes, produced an overall reduction of 98.8% of the BOD.

Distillery Wastes from Beer, Whiskey and Alcohol Distilleries. — These are commonly designated as "fermentation wastes" and are usually high in BOD, low in suspended solids and high in total solids. Biological methods have been successfully used, but the only recorded data of successful treatment by activated sludge is on yeast plant wastes in Germany[1]. It is stated that in one German plant, partial treatment of yeast waste by activated sludge produced reductions of the oxygen-consuming capacity of from 27 to 72 percent. Also, in another German plant, the yeast wastes, after dilution with 3 volumes of water, were treated by activated sludge with 24 hours aeration. It is also stated that satisfactory results on yeast factory wastes in Finland have been obtained by activated sludge, but no sustaining data are available.

Cannery Wastes. — Meagre data exists on treatment of these wastes alone by activated sludge. In the H. J. Heinz plant at Chambersburg, Penna.,[3] a process known as "Aeroflotation", utilizing an Infilco Aero-Cyclator was used, with a vacuum filter on the sludge. It is stated that this plant cost only 50% as much as a conventional biological plant and operated at a cost of $15.00 per 1000 pounds of COD (chemical oxygen demand) removed. The BOD removal was stated to do between 85% and 90% with a raw BOD of 430 ppm and a final of 72 ppm on a flow of 0.55 mgd. To assist in the process, 60 pounds of ammonia and 30 pounds of caustic soda were added daily.

At Celina, Ohio, where the cannery wastes are treated with the municipal sewage, the activated sludge process has proved effective.

Of the total population equivalent of 15,000 and 11,800 in 1952 and 1953, respectively, the waste represented all but 5000 of the population factor. Chemical precipitation was employed in the canning season to remove the bulk of suspended solids in the cannery wastes. The plant records show a reduction in BOD of 98.4% during the canning season for beets, tomatoes and potatoes. Operating costs were stated to be $7.30 and $9.00 respectively for the two years, per 1000 pounds of BOD reduced. Average raw BOD over 12 months was 427 ppm and final 9.9 ppm, with an average reduction of 97.8%.

Radioactive Wastes. — This, probably the newest type of waste to appear on the scene and one of the most dangerous from its radioactive tendencies which are harmful to humans, has been the subject of much experimentation at those isolated places where the wastes are generated. Ruchhoft[4] states that, in his opinion, the activated sludge process seems to possess certain advantages for application to the treatment of radioactive wastes because of: (1) The smaller size and cost of the treatment installation; (2) Greater control of the process and the ease in handling, removal and disposal of zoogleal charges that have become radioactive; (3) Greater flexibility for manipulation and modification of process; (4) Better possibilities for minimizing human exposure; and (5) Greater adaptability for experimentation on a laboratory and pilot plant scale.

It is stated that, with 23 hours aeration time and 1 hour sedimentation, the alpha count can be reduced from 100,000 to 3,900 or a reduction of 96%. Proposed treatment for these wastes is shown in Flowsheet #4.

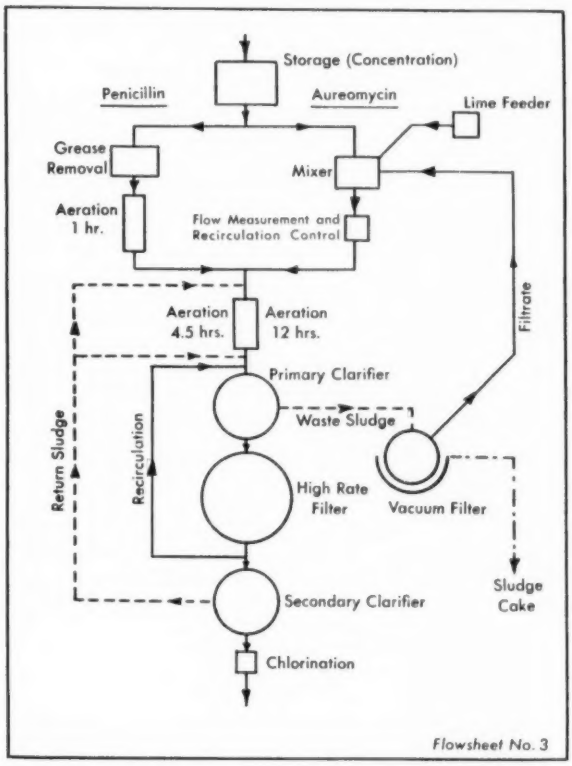
Beet Sugar Factory Wastes. — Records of treatment of this type of waste in the United States do not indicate the use of activated sludge, but Southgate[2] reports satisfactory results with lagooned, recirculated flume water containing about 2% process wastes, with trickling filters. This is taken to indicate that activated sludge would also be applicable, but no reported data are available, and detention and aeration periods and other essential data necessary to plant design are not known.

Wastes Containing Cyanide and Chromium. — These wastes have been troublesome and in most cases, have been disposed of by inclusion in the municipal sewage. At the Tallman's Island Plant, New York City, it was found that the discharge of 2 tons of chromic acid in 17 hours into a sewage flow of 18.0 mgd caused a cessation of nitrification in the activated sludge plant for 10 days, but the effluent BOD during this period was actually lower than the normal operation. The effluent was turbid until nitrification was restored.

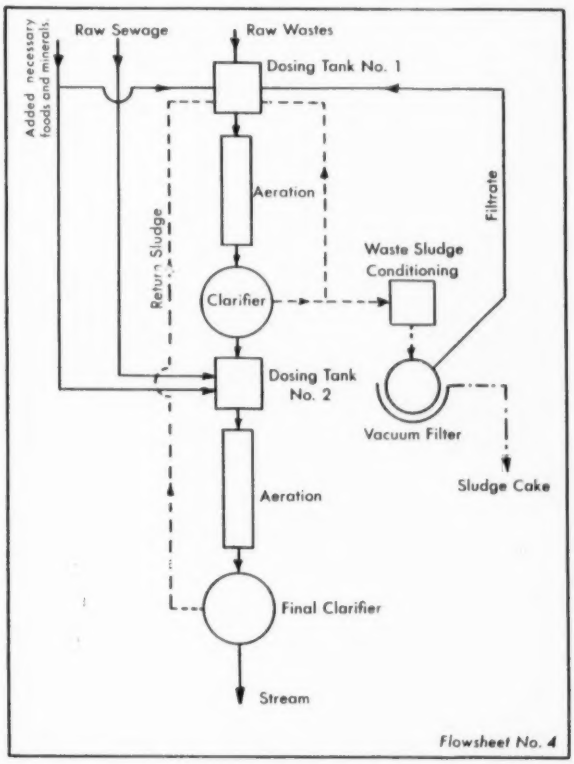
From Holland, Kessener reports that at Rochdale, England, a plant treating an average flow of 1.6 mgd containing wool scouring and dyeing wastes, tripe dressing wastes and gas works effluents, was equipped with his brush aerators. Detention period in the aeration tank was 19 hours.

Copper and zinc plating wastes can be tolerated in sewage and treated by the activated sludge process up to certain limits of concentration, but even with that, holding tanks are advisable to distribute the plating wastes over the total daily sewage flow.

(*Continued on page* 115)



● **COMPOSITE flowsheet showing methods of treating high strength antibiotics wastes with filters and activated sludge.**



● **PROPOSED flowsheet for treating radioactive wastes with two stage activated sludge, using an intermediate clarifier.**

● METHOD of making stereoscopic examination of mosaic in photo reading and photo interpretation studies.

HIGHWAY STUDIES FROM AERIAL PHOTOGRAPHS

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THE use of aerial photographs in highway studies is becoming standard procedure in most state highway organizations. The results from forty-five replies to a questionnaire sent by the writer in 1951 to fifty state and territorial highway departments indicated that thirty-six different organizations used airphotos in various stages of highway studies. Of the thirty-six, thirty-four used airphotos in reconnaissance, and twenty-nine in preliminary studies; nine highway departments indicated that they had used airphotos in conjunction with final location surveys. In most cases, the airphotos used were secured from governmental agencies, but twenty states indicated that they had procured from commercial aerial survey organizations special photos to meet their particular requirements and specifications. Six states reported that they operated their own aerial photographic sections.

The results of the questionnaire also indicated that airphotos are a valuable source of preliminary information with respect to soil-parent material surveys, drainage area surveys, estimates of runoff and constructional material surveys. By far the largest use is in determining drainage divides and watershed area estimates, as twenty-four organizations reported that they used airphotos in this phase of highway engineering.

The January 1951 issue of PUBLIC WORKS in an article "Aerial Surveys Save Time and Money" reported various ways that county engineers had used aerial photographs to secure basic map information. County engineers used them as an aid in preliminary road location studies, watershed studies, planning of dams, tax assessment studies, bridge location surveys and flood control planning. In almost every case reported, it was concluded that the use of aerial photographs to augment field surveys saved considerable time, and the surveys were much cheaper than if they had been made entirely by field methods.

Even though the above indicates the accepted use of airphotos in highway engineering studies, many engineers are still not familiar with the methods of obtaining such information to produce comprehensive engineering studies. It is the purpose of this article to explain the methods, and to point out some of their applications and limitations to highway studies.

There are three methods of using aerial photographs in highway studies. The method used most frequently by engineers is photo reading. The second method is photo interpretation which requires special background and training. The third method, and one very important in highway studies, is photogrammetry which requires trained technicians and special plotting instruments.

Photo Reading

Photo reading is simply the recognition of features that can be observed on airphotos. The only special training required (other than a highway engineering background) is in the use of a stereoscope to obtain a three-dimensional view of stereo-pairs of airphotos. Also, some knowledge of the characteristics of airphotos is desirable so that the reader can recognize scale limitations and the effect of relief dis-

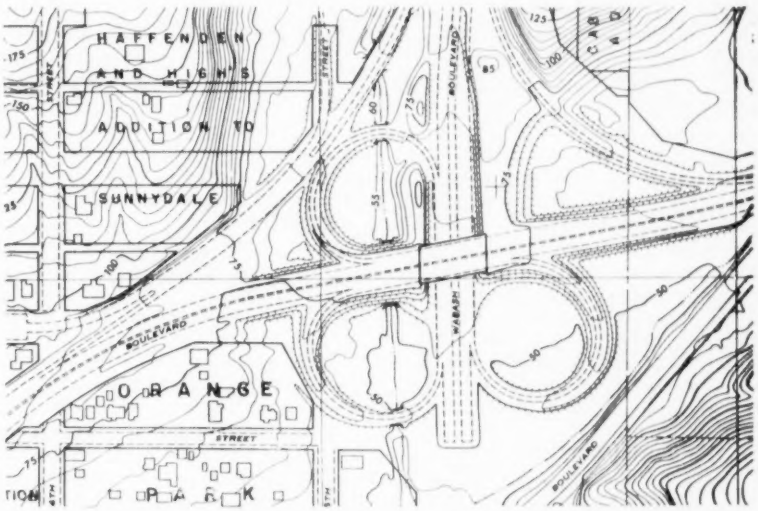
placement upon scale measurements.

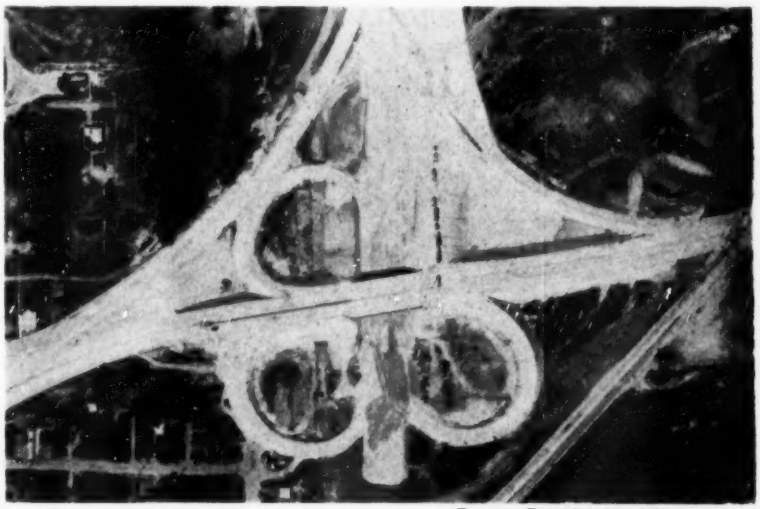
An airphoto records all features of the terrain. Stereoscopic study of airphotos reveals the shape of the land surface and the position of man-made features upon the land surface. Knowing the scale of the photos the photo reader can determine the position of the various features from known ground positions. This study is an essential part of reconnaissance and preliminary studies of alternate highway routes.

The usual procedure is to assemble an uncontrolled mosaic of several flight strips, and to study all possible highway locations between terminal points. The mosaic should be assembled from alternate prints in each flight line. With overlap between adjacent pictures of sixty percent or more, it is feasible to study the mosaic in "stereo" by using the unassembled prints. The engineer-photo reader can readily obtain information on land use from the mosaic, and relative values can be assigned to different areas according to their effect on highway alignment. Land values will be high in residential or industrial areas: therefore, a location can be selected that will least affect or give maximum benefit according to land use. In highly developed agricultural areas, the farm patterns can be studied and a location selected that will least disrupt farm layout; or, at least, a regional view of the new facility can be presented to show the land owner that he will actually benefit from the location proposed. In timbered areas or in areas where land use is mainly pasture, the location will be more on the basis of topography than land use. The engineer, by stereoscopic study of the mosaic, can select and adjust the location according to topography. The study of the wide band of terrain contained on the mosaic affords a more comprehensive view than it is possible to obtain by field surveys.

When several possible locations have been selected on the mosaic, the engineer can then study each route in detail to determine general alignment, right-of-way, number and general type of drainage structure and watershed area of each. The study of various natural tone gradations on the photos when related to topography by stereo-vision will help the engineers to avoid swampy or poorly drained areas. The engineer can make right-of-way studies from the photographs by comparing the photos with property ownership maps and tax assessment maps. He can compare the approximate lengths and alignments of the various routes, and, if topographic quadrangle sheets or photogrammetric topographic maps are available, he can compare relative quantities of excavation for each route. From a comprehensive study of this nature, the engineer can select one or two feasible route bands. Final location will be made by field surveys, or from a combination of large scale photographs (400 feet per inch or larger), 5-foot or 2-foot contour interval photogrammetric maps, and supplemental field surveys.

Photo reading is mainly applicable to preliminary studies of large areas. Photo scales necessary for such regional studies will naturally vary with the region, type of topography, and type of land use. Preliminary highway studies in rural areas can be obtained readily from scales ranging from 1000 to 1800 feet per inch. Aerial photographs that can be secured from various governmental agencies, such as the Production and Marketing Administration of the Department of Agriculture, are economical in cost and provide large regional coverage at a scale of approximately 1660 feet per inch. Many areas in the United States have been rephotographed for the government since World War II; therefore, the cultural features recorded are fairly up-to-date in comparison to pre-war photos. Some photos, in certain areas, may contain an excessive amount of vegetative cover that will hide ground details; therefore, new photography may be necessary. New photography should be obtained when trees are free from foliage, and should be ob-





Courtesy Fairchild Aerial Surveys, Inc.

● **AERIAL PHOTOGRAPH and topographic map, both shown to scale of 1"=400 ft.**

tained at scales of 800 to 1000 feet per inch for preliminary studies. These photo scales also have the advantage that the photos can be enlarged four or five diameters to provide planimetric detail at compilation scale of 200 feet per inch. These enlargements are very valuable in studies of urban areas where land use is intense. They can also be used in traffic studies, one-way street studies, and many other studies pertaining to highway planning in urban areas. By using a mirror stereoscope, it is possible to view enlargements, having 60 percent overlap, in the third dimension.

In many cases in urban area highway studies, the scales previously mentioned are not sufficiently large for the particular job requirements. Larger scales are also more valuable to the various planning groups in an urban area, therefore, these groups usually can share in the cost to secure stereo-coverage at scales of 200 to 400 feet per inch. Enlargements of these photos to 50 or 100 feet per inch of critical intersections, congested areas, traffic interchanges, grade separations, and bridge sites will provide considerable detail of such items as right-of-way, land use, alignment, and layout. An artist can portray the proposed improvement or even several different proposals on the enlargements, and these can be effectively used in planning sessions and public discussions. Many highway organizations use oblique photography for this purpose.

Photo Interpretation

Photo interpretation is larger in scope than photo reading. It requires not only the ability to read information from airphotos, but also the ability, by logic and deductive reasoning, to evaluate the significance of surface and subsurface features recorded on the photos. Considerable background and training is necessary to interpret the significance of such features as topography, drainage systems, erosional shapes and characteristics, photo gray tones, vegetation and certain man-made features. The photo interpreter should have sufficient background or training in geology and/or soils engineering to be able to interpret land forms, soil-parent materials, and variations in soils due to topographic position, soil moisture, and vegetation. A photo interpreter must also have knowledge of the general distribution of materials and how they can be or should not be used in engineering construction.

The technique of photo interpretation is applicable in highway engineering to the preparation of preliminary engineering soil strip maps along a proposed location. The method can also be applied to estimating runoff factors for watersheds or portions thereof. It also can be used in prospecting for materials of construction in the vicinity of a proposed location.

Photo interpretation requires a regional view of the terrain such as can be obtained by stereo-study of an uncontrolled mosaic. The mosaic will show changes in land forms that can be related to the origin of the earth's surface material. In certain areas, such land forms as kames, eskers, drumlins, and outwash plains are characteristic of materials deposited by glaciers. The surface features of glaciated regions contrast sharply with those of non-glaciated areas composed of various rock types, water transported materials or wind deposited materials. The photo interpreter is trained to evaluate and interpret these changes, and to make predictions or correlations of engineering problems associated with the materials.

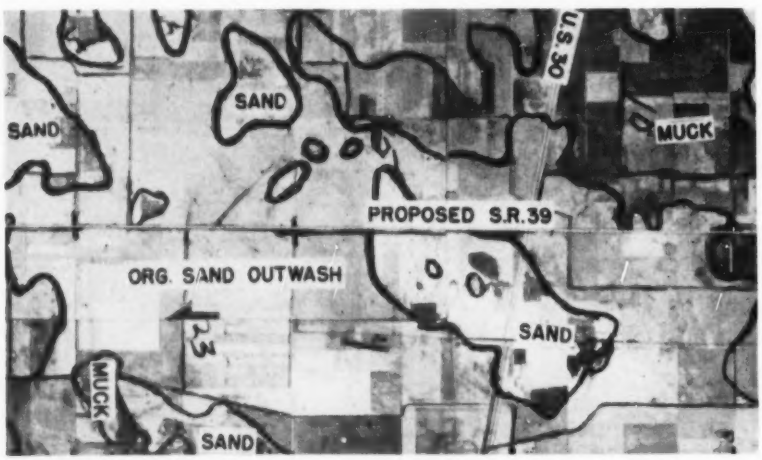
If the photo interpreter has a good background in soil science, he can make predictions within a parent material area of the texture of the surface soils as they vary with topography, drainage, organic matter, and profile development. Also, he can give tentative identification of soil types, and usually can predict the location of undesirable materials. Field investigations, soil borings and literature study are naturally an important part of the technique; but by judicious use of reconnaissance type field investigations and projecting such information by means of photo interpretation, a regional view of engineering soils along a proposed highway route can be obtained in much less time and cost than a detailed field survey.

The photo interpreter works on the regional concept of soil formation. He should, therefore, use a photo mosaic and stereo-coverage at scales of 1000 to 1800 feet per inch covering an area of three to five miles on each side of the proposed location. Recent government photos are suitable for such studies.

The writer has made soil interpretive studies from a single flight strip along a portion of a proposed turnpike on stereo-photos at a scale of about 1000 feet per inch. Such a study was naturally limited in that a regional view of parent material distribution could not be obtained from a single flight strip. If government photos at 1660 feet per inch or several flight lines covering a band eight to ten miles wide had been available for the regional study, then the 1000-foot scale or even larger scales (400 to 600 feet per inch) would have been excellent for the detailed study along the proposed route. Such a combination of scales would also have the advantage of comparative pictures taken at different seasons and different years. Comparative pictures are very valuable in photo interpretive studies especially if one set is secured during the wet season or shortly after a heavy rain. Much information can be inferred on the permeability of various soil areas which is important in estimating soil characteristics and runoff conditions.

A very important method of ob-

(Continued on page 140)



● **PHOTO INTERPRETATION: Soil survey along proposed highway. Note contrast between organic terrain and sand and gravel outwash plains.**

SOLVING The Subdivision Sewage Disposal Problem

C. E. WRIGHT

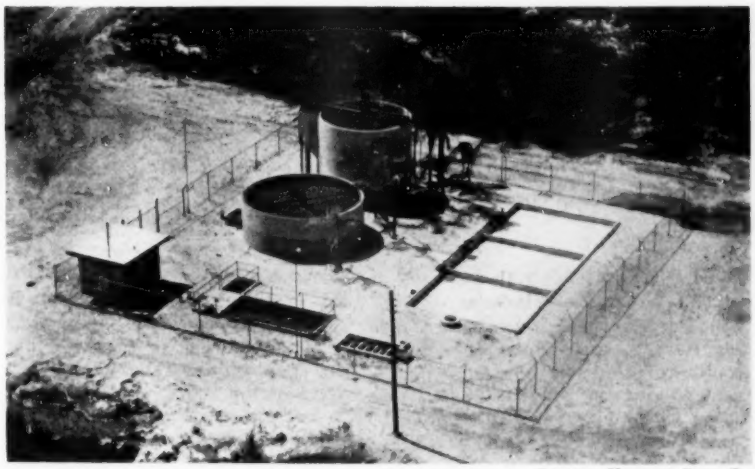
A method by which three privately financed sewerage systems are being built by developers of new subdivisions and then turned over to the city for operation and maintenance under a long-term amortization plan, with the city eventually owning the facilities, has been successfully worked out in St. Petersburg, Fla.

The new subdivisions lie beyond the present St. Petersburg sewerage system, so it was not considered feasible or fair to ask the taxpayers of the city to pay for extensions that would, at present, benefit only a relatively few residents. However, an underground sewer system was essential for each subdivision as the water table of the properties is so high that septic tanks would not be practical.

Hence the developers agreed to build their own sewerage systems, including temporary disposal units, on a basis whereby they pay all costs of installation except engineering, which has been done by the City Engineer's office. Upon completion, the units are turned over to the city for operation and maintenance. Individual users of the system pay a monthly service charge which approximates 30 per cent of their monthly water bills, usually a moderate charge as most lawn sprinkling in the St. Petersburg area is done from private wells.

Of the amounts collected, 60 per cent goes to the developer until his investment in the system has been liquidated, but not longer than 20 years, whichever comes first. The remaining 40 per cent goes to the city to cover its cost for operation and maintenance. Reimbursement to the realty developer covers only the collection system and the lift station, but not the treatment plant, which will be abandoned when the local system is finally connected with the city system. The cost of the complete system is about $300 per dwelling.

In the three realty developments, provision is being made for eventual service to about 1400 homes, but in each case the original installation will serve only about half the number of homes that may ultimately be built. The capacity of the plants will be doubled when more than 50 per cent of each area has been developed.



Courtesy Yeomans Bros. Co.

● **MODERN and complete sewage treatment plant for a subdivision is moderate in cost. Provision is made to increase capacity as areas are developed.**

Work on the first of these privately financed systems was started last fall by the J & P Corp., a developer of two new adjoining subdivisions, Hampton Development and Garden Manor; and by Azalea Homes, Inc. The J & P developments have been planned for a total of 800 homes and the Azalea development for 600. A third project, which contemplates the construction of 1100 homes, is being carried out by Florida Builders.

Design of the sewerage systems, which are identical, has been worked out by City Engineer Paul J. Jorgensen and his staff. The systems consist of 8 and 10-in. vitrified clay sewer mains, laid at depths ranging from 3 to 14 ft. below ground level. These lines carry the sewage to a lift station, where three Yeomans automatic pumps, two 150-gpm and one of 300-gpm, pump the sewage into a Spirahoff digester, which is a modified Imhoff tank. From the settling tank, the effluent flows through a high rate filter into a final settling tank, which has a built-in chlorinating chamber. After chlorination, the effluent flows into an outfall sewer, which discharges into a ditch. Sludge beds are also provided for drying the sludge which will be removed from the Imhoff tanks. A gasoline driven pump is provided at each lift station as standby equipment.

These disposal units are considered to be temporary, though they may serve for some years, or until the city's mains are extended to reach these new developments. At that time, whenever it may be, sewage from these developments will flow to one of several proposed major city treatment plants. Since one of these new developments is more than three and a half miles from existing mains, it may be some time before the in-between area has grown sufficiently to warrant extension of the city's mains.

As St. Petersburg has almost doubled in population since 1940 (from 60,000 to about 110,000) and has issued approximately $150 million worth of building permits since the end of World War II, of which about a third has been in the past two years, it has had the problem of all fast-growing communities in not being able to keep up with the additional requirements for public utilities. Thus the plan here outlined has made it possible for real estate developers to carry out their building programs without waiting for city authorities and the citizens to authorize bond issues or special levies for quickly needed facilities.

Toledo's CROSS-CONNECTION PROGRAM

PAUL KIEL, Water Department, Toledo, Ohio

AND

EARLE HOYT, Ohio Department of Health

DURING World War II, our present Water Commissioner, G. J. Van Dorp became impressed with the Army's cross-connection program in industrial plants, which was conducted by the Sanitary Corps in conjunction with the Internal Security Program. Within a year after his appointment as Water Commissioner in 1946, Mr. Van Dorp reactivated the cross-connection program which had been dormant in Toledo since the days of WPA. He was confronted with the problem of setting up an effective program and the administration of it. A policing program was followed at first, but in 1951 this was changed to an educational program assigned to the Engineering Section of the Water Department. A new and complete system was initiated, including permanent sketches of all plants, along with a cost analysis of the program.

Charging an inspection fee for such work appears to be justified and to have several advantages. It will reduce the number of potential hazards; encourage plants to maintain separate systems for potable and non-potable waters; and keep management constantly aware of the problem. The expense for this special service would seem to be properly charged to those demanding such service rather than to all users of the City water. Such a fee is not now being charged, but it may be imposed in the future.

It is the responsibility of the Division of Water to deliver a safe and potable water to the consumer and to protect the water in its distribution system. Therefore, there cannot be any direct connection to any water supply, over which the Division of Water has no control, or which is not approved by the State Health Department.

The Division takes weekly bacteriological samples throughout the entire distribution system and in the event a sample shows contamination, the streets in the given area are checked from the master list for existing well supplies that may have been reconnected into the City supply and steps are immediately taken to recheck the area for violation.

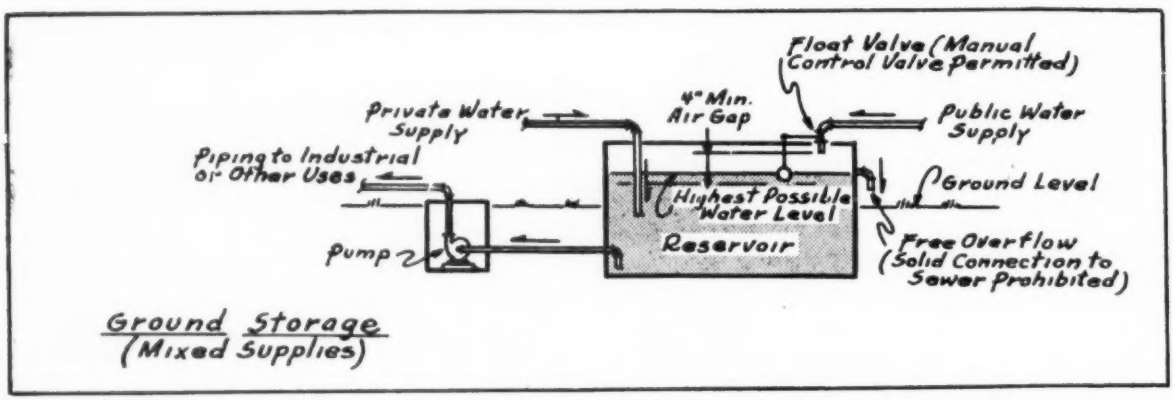
It is recognized that some industries need more than a single source of supply of water to provide uninterrupted service, or to provide additional or secondary fire protection. Some industries are so dependent on water that a brief interruption in the supply would jeopardize their equipment, processes or final product. Bearing in mind the proper protection of the quality, safety and public health aspects should be given first consideration while the economic considerations are secondary but important.

The Ohio Department of Health recognizes four methods of making dual water supplies available, where necessary, by safe methods. (See Ohio Department of Health Bulletin, "Cross-Connection Control in Ohio" 1951.) These four methods are listed below:

1—Free Discharge
2—Interchangeable connection
3—Removable pipe sections
4—Double sanitary check valves

These methods have been adopted as the City of Toledo standard and as the basis of the present program.

After the basic methods and the policy were adopted, the program was divided into two classes of inspections: (1) Domestic—private



● USE OF air gap to prevent contamination of public water supply when two sources of water are used.

dwellings that were occupied prior to buying a city tap; (2) industrial —industries, commercial establishments, department stores and hotels that have an auxiliary or stand-by water supply.

Inspection Work

The Contract Section of the Division of Water prepares a list of water taps sold to private dwellings that were occupied before they applied for city water (dwellings under construction are not included in this list). Every Friday this list is submitted to the Engineering Section and the names are entered on the master list. Periodically, the inspector reviews the list and routes his inspections, thereby enabling him to make these inspections with the least amount of travel.

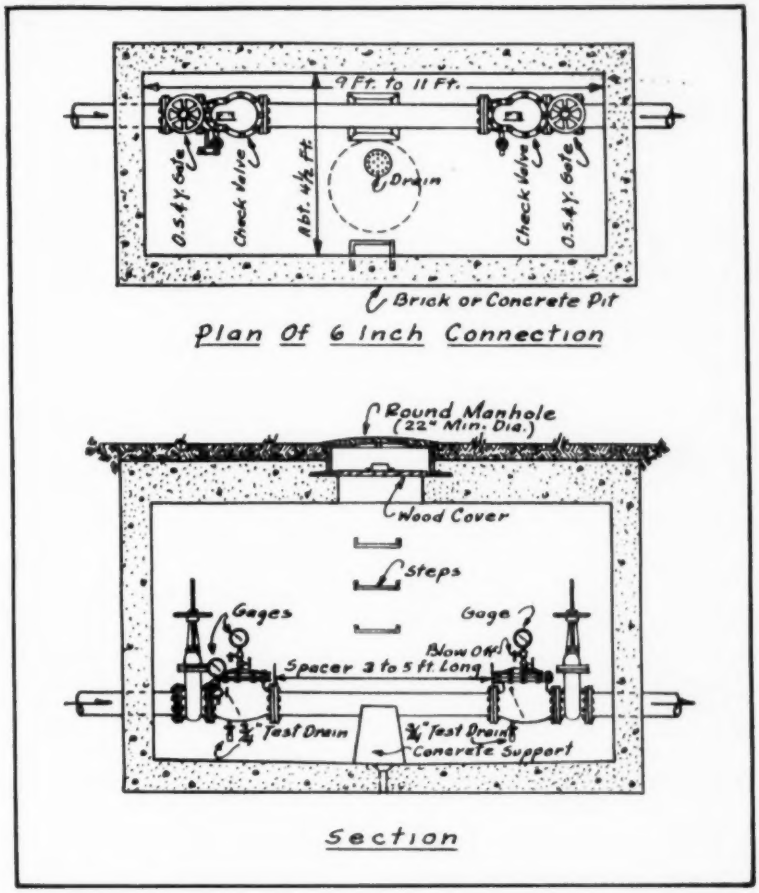
Inspections are made to determine the source of water prior to buying city water. If a private well was the source, then the owner is informed that no connection between the well supply and the city supply will be allowed; and in some cases it has been recommended that the well be entirely abandoned.

In an area where there are low pressures, the consumer may attempt to use his private well supply to augment the low city pressure. This happens primarily during the summer months. If the private well is abandoned, there is no danger of a cross-connection but as long as the consumer has the well and pump, he may be tempted to cross-connect, not realizing the danger involved.

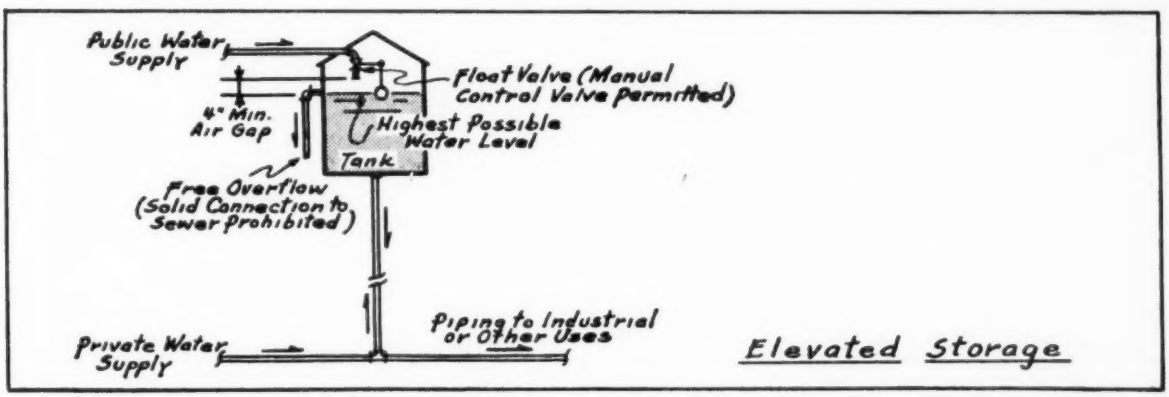
Upon completion of the inspection, the date and the remarks along with the inspector's initials are entered on the master list, maintaining a complete record.

All industries, commercial establishments, department stores, hotels, etc., are inspected first to determine if they have an auxiliary, or stand-by water supply system. If there is an auxiliary water supply, the inspector makes a more thorough inspection and prepares a schematic drawing of the two systems, using red lines to indicate the unapproved supply and blue lines to show the approved city supply. All cross-connections are then circled. A letter is sent to the plant along with the sketch. Attached to the letter is a schematic drawing and a sketch showing the recommended method of elimination, using typical drawings furnished to the city by the State Department of Health.

(Continued on page 132)



● **DOUBLE CHECK** valves for fire service only, with no regular use of water beyond valves and system normally filled with public water.



● **WITH ELEVATED** storage, air gap is also used to prevent contamination from secondary water supply.

How and Where

● APSCO base paver laying 14 inches of loose stone for a compacted 10-inch base course 12½ feet wide for heavy duty runways at Columbus, Ohio, airport.

FRED E. SWINEFORD
Engineer-Director
Macadam Pavements, Inc.

THE need for adequate bases for pavements is recognized more today than ever before. Base courses are now required under every type of pavement, for experience has shown that pavements laid on plastic or unstable soils will not stand up under the heavy loads of today. Flexible pavements must have thick bases to distribute the wheel loads over a large area of the subgrade. Rigid pavements require stable, non-plastic bases to prevent pumping and breaking of the slabs. Adequate surface and sub-surface drainage is essential for all types of bases.

Macadam bases may be designed of sufficient thickness to distribute the expected wheel loads over a sufficiently large area of the subgrade so that the bearing capacity of the subgrade will not be exceeded. Various types of macadam bases are used such as waterbound macadam, drybound macadam, bituminous macadam, etc.

Waterbound macadam may be used for the first or second base course. It consists of large sized angular crushed rock (stone or slag) compacted and filled with finely crushed rock, then saturated with water. Drybound macadam is built like waterbound macadam except the watering is omitted. Under either of these base courses it is best to spread one or two inches of stone screenings as insulation against the intrusion of clay or mud into and between the big stones. Such intrusion of clay would lubricate the rock particles and permit them to move, whereas the crushed rock and screenings interlock, and high internal friction is imparted to the mass which prevents any one particle from rotating with respect to its neighbor.

Waterbound and dry - bound macadam, formerly laid in courses four to six inches thick, are now being laid eight to ten inches thick with the aid of vibration. The crushed rock for these thick courses is spread through a self propelled mechanical spreader; then the lower part of the course is compacted by a heavy vibrator and the upper part compacted by a heavy roller.

Filling the voids with finely crushed rock is also accomplished with combined vibration and rolling. After the course is compacted to refusal, one-half of the screenings required to fill the course is spread. These are jarred into the lower half of the course by a heavy self-propelled vibrator; then one-fourth of the filler screenings is applied and vibrated into the voids; finally the last one-fourth is applied, vibrated and rolled. These thick courses of macadam are stronger and cost less than the same total thickness constructed in two thin courses.

One-course macadam bases 8 ins. thick have been laid for heavy duty airport runways at Binghamton, New York; Beaver Falls, Pa.; Chattanooga and Nashville, Tenn.; Beckley, W. Va.; and Columbus, Ohio. Such bases have also been used on a number of highway pavements. As a result of the success of thick macadam courses for heavy duty roads and runways the ten-mile test road at Columbus, Indiana, includes an eight-inch, one-course, waterbound macadam base of crushed stone macadam.

Specifications for macadam courses up to ten inches thick have been adopted by the CAA, the Navy and the States of Ohio, Virginia, and North Carolir , also on certain projects by the Army and in Pennsylvania, New Jersey, and Indiana. All of these specify that both vibration and rolling shall be used on thick courses. Macadam courses up to five inches thick are best laid by rolling only and from five to ten inches by vibration and rolling combined.

Bituminous Macadam

Bituminous penetration macadam courses of compacted, crushed rock, cemented together with a bituminous binder and with surface voids filled with smaller keystone are used for intermediate base courses. The 118-mile New Jersey Turnpike has eight inches of penetration macadam for its principal base course. Likewise the four-lane National Pike now under construction south of Frederick, Maryland, has a three-inch bituminous penetration course over eight inches of waterbound macadam. Four inches of asphaltic concrete was then laid over the bituminous macadam.

Bituminous penetration macadam has so much stability and toughness that it is being used not only for surface courses and intermediate base course but for a strengthening and insulation course over broken rigid slabs which need resurfacing. New York State, in 1952, resurfaced 34 miles of State Route 5 west of Buffalo with four inches of penetration macadam topped with two

to Build Macadam Bases

and one-half inches of dense asphaltic concrete. It was found that when the broken and pumping slabs were surfaced with hot mixed asphaltic concrete only, pumping continued; but when a four-inch course of penetration macadam was placed over the broken slab prior to laying the hot mix, pumping ceased and few cracks came through.

Another modification of macadam is a base of medium size crusher-run rock or slag including the fine screenings. This is spread, bladed and rolled at the proper moisture content. It was used as a subbase on the New Jersey Turnpike and the Oklahoma Turnpike. Other types of bituminous macadam bases for courses thinner than ordinarily specified for penetration macadam are those known as bituminous premixed base and leveling courses. These are composed of smaller aggregate than that used in penetration macadam and are mixed with bituminous binder in a stationary or travelling plant or mixed on the road. Such mixtures are spread with a mechanical spreader and are especially well adapted to leveling up old, rough pavements.

Riding quality, stability, and durability of pavements depend on good construction methods and adequate control from the subgrade to the surface. The load carrying capacity of the macadam bases on the New Jersey Turnpike was tested with 50-ton super compactors and all defective areas were repaired. The finished surface was tested and conformed to the requirement of ⅛ inch variation in 16 feet. Since variations in the subgrade will show up in the finished surface, the subgrade must be checked by lines and templets to make sure it conforms to cross section and profile. The base courses will not correct ups and downs in the subgrade. Soft areas in the subgrade will result in low spots in the finished surface. Finished grade stakes should be set every 25 feet on both sides of the pavement. From these the subgrade and every succeeding course must be checked and corrected if necessary. From the grade stakes the contractor should set iron pins along both sides and on the center line. Longitudinal chalk lines between these iron pins provide line and profile for the guides on the mechanical spreaders and pavers. These lines also provide a guide for the transverse screed and templet. For quick checks, the roller eye method is used, as follows: Stand behind a roller moving over the course. Fix your line of sight over the top of the big roll on a distant object like a telephone cross arm.

The rock for the macadam base and surface course should be spread to a uniform thickness true to crown and profile. Compaction of these courses should continue until the roller wheels or truck tires do not disturb the stone.

Waterbound or drybound macadam bases should be filled with several applications of screenings. The applications of screenings must be light enough so that they will not crust on the top but go down and fill the voids from the bottom up. With vibration and rolling combined three applications of screenings will fill an eight-inch course. With rolling only, no more than a six-inch course can be filled and the number of applications of screenings should equal the number of inches in the depth of the course. Filling the voids should follow closely behind the coarse stone so as not to leave the course open and permit rain to go through and soften the subgrade.

Waterbinding should continue until the stone is thoroughly wetted to the bottom of the course. Any pools of water standing on the course show where there are low areas which should be corrected.

A prime coat of light bituminous material is desirable on waterbound or dry-bound macadam bases which are to be covered with asphaltic concrete. Prime coats are not necessary where a bituminous penetration macadam course is laid on such bases. Bituminous macadam base courses need no seal coat but a good seal is necessary when they are used as surface courses.

This article is based on a paper which was presented at the 1953 Ohio Highway Engineering Conference.

● **VIBRATING macadam base 10 inches thick. Consolidation is accomplished by vibration and rolling using special equipment.**

● **BITUMINOUS MACADAM base with slag aggregate, showing rolling and penetration with hot asphalt binder.**

DESIGN TAKES THE GUESSWORK OUT OF TRICKLING FILTERS

OLNEY BORDEN,
Consulting Engineer, Liberty, N. Y.

WITHIN a 15-mile radius of Liberty, N. Y., there are nine sewage treatment plants that use trickling filters for the secondary treatment of sewage. The majority of these use high rate filters with various rates and stages of recirculation.

The use of trickling filters for the secondary treatment of sewage and industrial wastes has become almost universally accepted by sanitary engineers the world over; and rightly so. In addition to the long-tested low rate filter, there are a number of patented methods of applying sewage to the filter, and all of them give good results in BOD reduction. Our long experience with trickling filters permits us to estimate what results will be accomplished by the treatment process. How well the engineer can predict the results to be obtained in specific cases is the subject of this article. Three of these nearby plants—Sackett Lake, Kauneonga Lake and Woodridge—have been selected for discussion here; but what is said of them is quite universally applicable to most or all of the plants in this nearby area.

The plants I will discuss have different rates of recirculation and different depths and kinds of filter media. Each of the three plants will be presented separately as to the basis of design and the operating results that have been obtained.

Village of Woodridge

The original sewage treatment plant for this resort village was constructed in 1936. It included two 30-ft. circular primary clarifiers; one 93-ft. trickling filter 8 feet deep; one 30-ft. secondary clarifier; one 22-ft. unheated digester; and a hand-cleaned bar screen. A grab sample taken in July, 1946, showed this old plant reducing the BOD from 330 ppm of raw sewage to a final effluent of 42 ppm. This effluent was objectionable in the stream into which it was discharging and objectionable odors were coming from the plant because the siphon chamber overflowed during most normal daytime high flows.

This plant was remodeled in 1947 by the construction of a new siphon chamber; laying new larger pipes from the primary tanks to the siphon and from the siphon to the distributor; installing a new and larger capacity distributor; and installing pumps and lines for two-stage recirculation.

The basis of the design for the plant modernization was for a population of 3,000 persons at 0.16 pound of BOD and a laundry flow of 300,000 gpd, with a BOD of 300 ppm, giving a total BOD loading of 1250 pounds on 2,010 cu. yds. of stone. The average summer flow is now 600,000 gpd and the winter flow averages 200,000 gpd. The recirculation consists of pumping back 500 gpm of filter effluent to the primary inlet valve and 250 gpm from the secondary clarifier to the siphon chamber. The Engineer's Report to the N. Y. State Department of Health stated that, with this revised use of the filter, an effluent of 30 ppm could be expected.

The results shown in Table I were obtained from 5-day BOD tests taken in 1952 and 1953.

It is significant that the final effluent in both years compares favorably with the basis of design, and the reduction in BOD through the filters is almost exactly the same —80% each year. The secondary recirculation system was out of order in 1953 but from the 1952 test it was found to have very little effect in the final results anyway.

This plant is operated by one man, Jack Blinder of Woodridge, N. Y., who also operates the village water supply system and is street superintendent in his spare time. Mr. Blinder estimates that he spends an average of three hours per day in the operation of the sewage treatment plant. The primary clarifiers are overloaded by the amount of the recirculation which further complicates the operation of the plant; but this plant serves to demonstrate the fact that good results can be obtained from a plant that has a good trickling filter, even with overloading of the clarifiers and a minimum of operational attention.

Kauneonga Lake

The Kauneonga Lake Sewer District was established in 1936 and a sewage treatment plant was built consisting of a bar screen; Imhoff tank; trickling filter with ungraded gravel for media and using spray nozzles; and a combined final settling and chlorine contact tank. Several extensions were made to the original district and the plant became so badly overloaded that plans for a new plant were started in 1950.

The new plant uses the old bar screen, a new 40-foot clarifier, two 40-foot trickling filters with four-arm rotary distributors, a 40-foot final clarifier and the old final settling tank as a chlorine contact tank. Dorr equipment is used in the clarifiers and the filters. The Imhoff tank was converted into an unheated digester. For first-stage recirculation a pump returns 300,000 gpd of the primary filter effluent to the inlet of the primary clarifier. The remainder of the effluent from the primary filter, plus recirculation from the secondary clarifier, is

Table 1—Operating Results at Woodridge, N. Y.

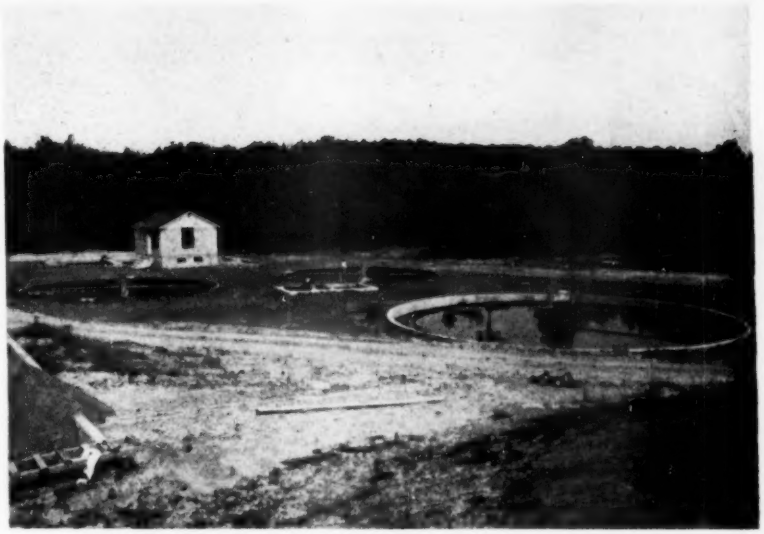
	Aug. 15, 1952		*July 13, 1953*	
	BOD	**SS**	**BOD**	**SS**
Raw Sewage	240	144	520	732
Pri. Influent	190	—	290	—
Pri. Effluent	153	—	160	—
Filter Effluent	30	—	35	—
Final Effluent	29	24	26	27

1952 flow 0.5 mgd; 1953, 0.6 mgd. No secondary recirculation in 1953. Strength of raw sewage in 1953 test was affected by fact that samples were taken on Monday, no sludge having been drawn on the preceding day.

pumped at the constant rate of 900,000 gpd to the siphon chamber for the dosing of the secondary filter.

The basis of design of the new plant was for a population of 6,000 persons with a flow of 600,000 gpd. The clarifiers give a 2-hour detention with 0.5 recirculation ratio. The loading on the filters was figured at 1.88 pounds per cubic yard. On this basis of design an effluent with a BOD of 25 ppm was expected.

The funds available for the construction of this plant were very limited and economies had to be adopted wherever possible. The ungraded gravel in the old filter was washed on the job and used in the new filters. This gravel varied in size from 4 inches in diameter down to about 25% of No. 1 and No. 2 gravel with only about 50% of all the sizes crushed. Some concern was



● **HIGH RATE filter at Sackett Lake has produced very good results.**

● **CONVERTED from a low rate filter, Woodridge plant has worked well.**

felt for the results to be obtained from the use of this type of filter media.

Grab samples taken late in the summer of 1950 while the old plant was still in operation showed that the raw sewage had a BOD of 440 ppm and that the final effluent was 62 ppm.

On August 15, 1952, after the new plant had been in operation two months, 5-day BOD tests showed raw of 240 ppm and final of 36 ppm. It was noted at that time that considerable washings from the old gravel in the filter were still coming into the recirculating sumps and undoubtedly were affecting the tests. Tests taken on July 13, 1953, with composite samples from 8 AM to 3 PM showed results stated in Table 2.

The volume of flow on the date of the test was 600,000 gpd, that is, the rated capacity of the plant due to the samples being taken on a Monday during the peak of the summer season. The final effluent at 22 ppm BOD compares favorably with the expected result of 25 ppm on the basis of the original design. The reduction of 70% in BOD through the filters is considered very good on the basis of the poorly graded filter media. The 1.5 recirculation ratio to the secondary filter shows good results in this filter. This plant is operated by a full-time operator whose only other duty is the care of three small sewage pumping stations.

Table 2—Operating Results at Kauneonga Lake, N. Y.

July 13, 1953

	BOD	SS
Raw Sewage	300	212
Primary Influent	200	—
Primary Effluent	140	—
Pri. Filter Effl.	136	—
Sec. Filter Infl.	105	—
Sec. Filter Effl.	43	—
Final Effluent	22	9

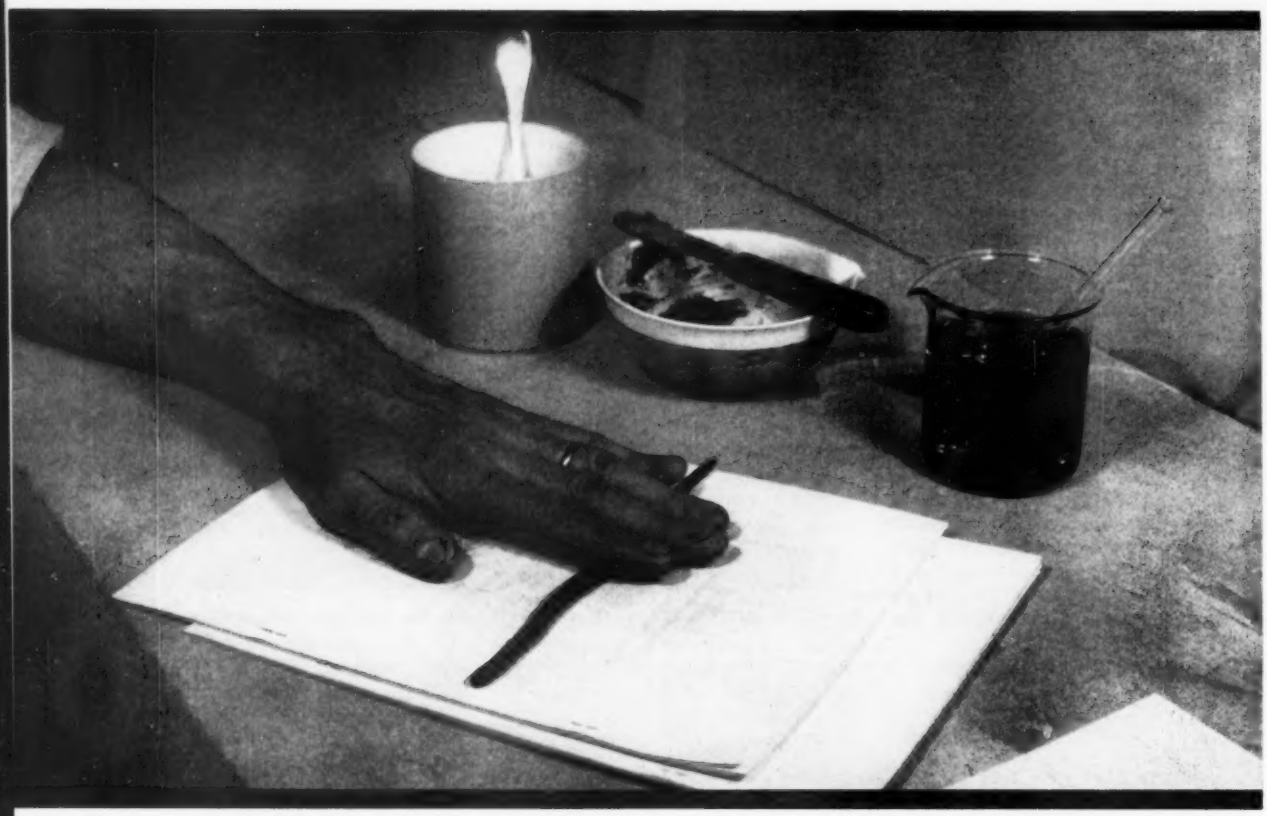
Sackett Lake

The construction of this plant was started in the fall of 1950 and it was completed and put into operation in the spring of 1952. This plant differs materially from the first two in that it is a complete new plant for a newly formed sewer district. It consists of a bar screen, a 40-foot primary clarifier, two 40-foot diameter stone filters 4 feet deep and a 40-foot diameter secondary clarifier. It provides two-stage recirculation. Primary recirculation is at a rate of 500,000 gpd from the primary filter effluent back to the inlet of the primary clarifier. Secondary recirculation is at a rate of 1,000,000 gpd from the secondary clarifier to the siphon for the secondary filter.

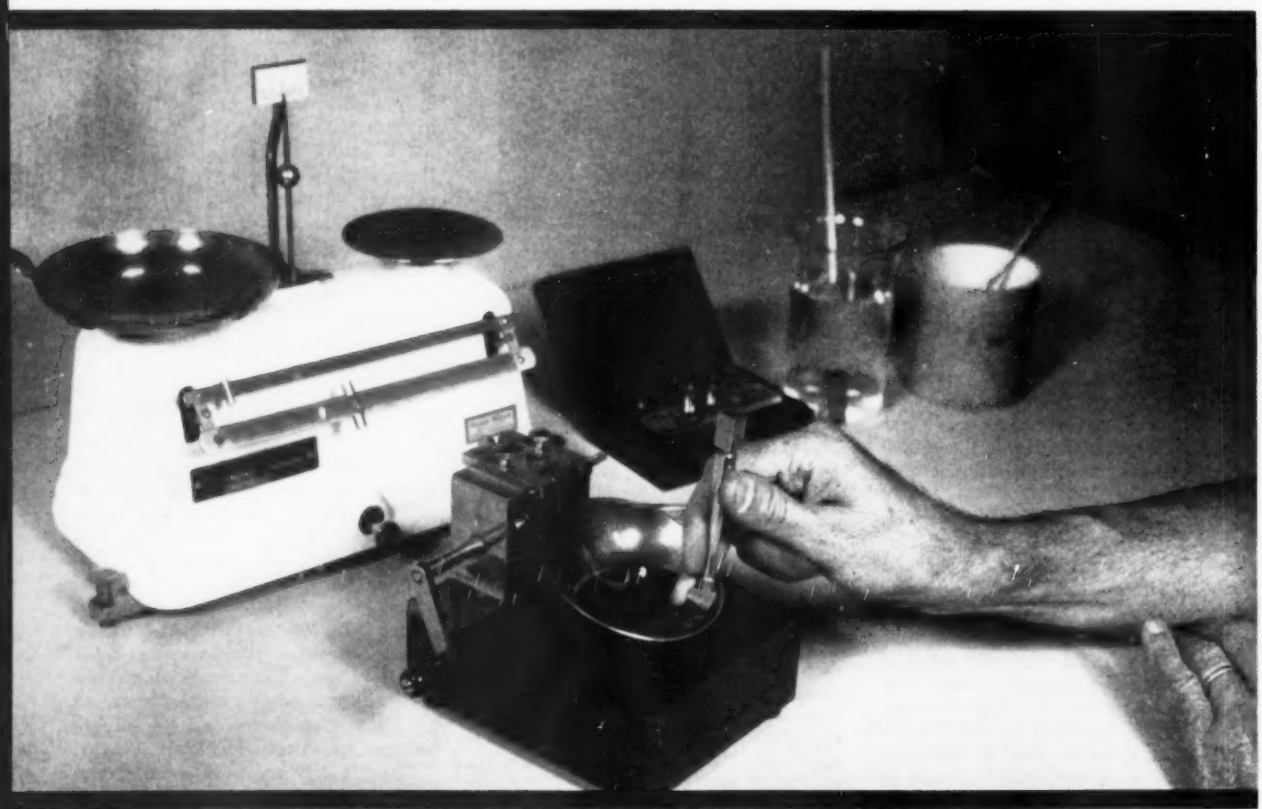
The basis of design is for 500,000 gpd of sewage. Clarifiers provide for 2 hours of detention including the recirculated flow and filters are designed for 2.25 pounds of BOD per cu. yd. of stone. An effluent of about 20 ppm BOD was anticipated under full loading with the above conditions. The clarifiers and distributors have Dorr equipment; the recirculation pumps were furnished by Fairbanks-Morse and the sludge pumps by American Well Works.

The plant is operated by one man who also checks the sewer system

(*Continued on page* 114)



● **PLASTICITY TEST — Rolling the soil mass with the fingers into a thread ⅛ inch in diameter.**



● **LIQUID LIMIT TEST — Cutting the groove in the prepared soil sample with a known moisture content**

SOIL ENGINEERING

Second Installment

This installment of Prof. Ritter's article continues the discussion of basic soil properties and their meaning, describes the laboratory tests and presents the soil classification systems. The final installment will appear in the October issue.

by LEO J. RITTER, JR.

Compressibility

BY compressibility is meant that property of a soil which permits it to deform under the action of a compressive load, which for present purposes is generally visualized as acting vertically downward. The soils with which we are concerned are confined—that is, they are prevented from moving or flowing laterally, generally by the soil which surrounds them—and are saturated.

In a general sense, all soils are compressible. This means, of course, that all soils undergo a reduction in volume (thickness) upon application of a compressive load. In saturated soils, this reduction in volume is attributed to a reduction in volume of the void spaces in the soil rather than to any reduction in size of the individual soil grains or of the water which exists in the voids. If the soil is saturated before the load is applied it is apparent that some of the water must be forced from the voids of the soil before compression can take place; if the water can not escape there will be no reduction in volume under our assumptions. Thus the time rate of compression is a function of how rapidly the water can escape from the soil, that is, the permeability. The magnitude of the compression which will occur in a given soil under a given set of conditions depends upon a number of different factors, including such things as the void ratio, structure and past history of the soil mass, and the magnitude and method of application of the load.

In a practical sense the compression of coarse grained soils, such as sand and gravel, is rarely a matter of concern. This is because the amount of compression is likely to be quite small and the compression will occur very rapidly after application of the load, provided only that contained water can escape. Generally speaking, all the compression that is going to take place will occur during load application.

The compression of a fine-grained soil, particularly some clays, is another matter, however. The amount of compression may be very great and the time required for the compression to occur may be very long. An approximate comparison of the magnitude of compression for a typical sand and a typical clay, as well as an indication of the time required for the compression to take place, is shown in Fig. 7, page 86.

A specific name is given to the process of compression of a confined, saturated clay soil under the application of static compressive (generally vertical) load; this process is called "consolidation". That part of the load or stress carried by the water is called "neutral stress" or "neutral pressure"; that carried by the soil grains is "intergranular" or "effective" stress. The process of consolidation really involves three things; (1) the gradual transfer of load from the water contained in the voids to the solid phase or "soil structure"; (2) the gradual escape of water from the voids because of the hydraulic gradient created by the application of load; and (3) the gradual compression or reduction in void ratio of the soil mass. The consolidation of thick, compressible clay layers is a difficult practical matter. Uniform settlements because of consolidation may be only annoying, as in the case of some of the hangars at La Guardia Field, N. Y., which have settled several feet below the surrounding ground; or relatively serious, as in the settlement of an embankment

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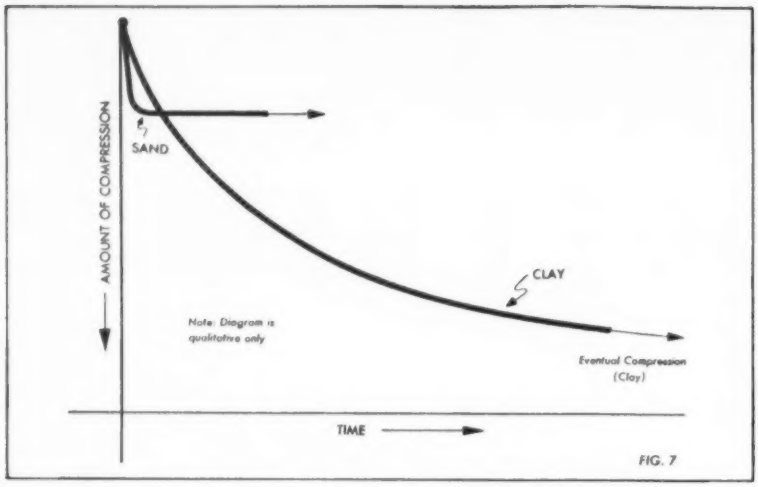
Table 2 and Figs. 16 and 17 are from "Highway Engineering", by L. J. Ritter, Jr., and R. J. Paquette, The Ronald Press, 1951.



● **QUALITATIVE compression-time relationships for typical sand and clay soils.**

forming an approach to a large bridge. When the settlement is not uniform—and we have differential settlements—in may be structurally serious.

Consolidation characteristics are determined by laboratory "consolidation tests" performed upon undisturbed samples—samples in which the natural structure, void ration and moisture content are preserved as carefully as possible. A simplified sketch of a consolidometer and loading assembly is shown in Fig. 8.

In conducting the consolidation test the undisturbed sample is trimmed to fit the exact size of the consolidometer ring (a typical size is 2½ inches in diameter and one inch thick). The equipment is then assembled, arrangements made for reading the change in thickness of sample under load, and the first load applied. Dial readings indicating the reduction in thickness are taken at selected time intervals. The first load is allowed to remain in place until virtually all movement of the dial ceases. The load on the sample is then increased and the process repeated. Typical increments of load might be ¼, ½, 1, 2, 4, 8 and 12 tons per square foot. Loads on the sample may also be decreased gradually if information is desired on the "rebound" characteristics of the soil. A typical test would require about a week to perform.

Two very important sets of data are obtained from such a test. One of these is the void ratio-pressure curve for the test as a whole, which is illustrated in Fig. 9; the other consists of the time-consolidation curves for each increment of load. Results of the consolidation test, when properly used, can frequently be extended to give reasonably accurate predictions of the magnitude of settlements which will occur for a structure in a given location; time-settlement relationships may also be predicted, although less accurately. Complete steps involved in a settlement analysis for a structure include the following:

An exploration program at the site of the structure, with a view toward obtaining complete information as to the nature and extent of the underlying soil and/or rock layers, the position of the ground water table, etc. If this exploration indicates that settlements large enough to influence design may occur, other procedures will include:

(1) A laboratory testing program utilizing undisturbed samples of compressible soil layers.

(2) A careful review of the characteristics of the structure planned for the site.

(3) A stress analysis, including the determination of vertical stresses (loads per unit of area) in the compressible soil layers involved.

(4) A settlement analysis, combining information from the four previous steps and predicting the magnitude of the ultimate settlements and time-settlement relationships.

It should be emphasized that the four steps outlined above would be necessary only if it was felt that settlements might be large enough to influence the design of the foundation or of the structure itself. For example the settlement analysis might show that the shallow spread footings which had been planned as a foundation for a particular building would not be satisfactory because excessive differential settlements would occur. Some other type of support, such as a pile foundation, might then be necessary to protect the structure against the consequences of excessive settlement. In an extreme case the prediction of excessive settlement might force the abandonment of the site which had been tentatively selected for the building.

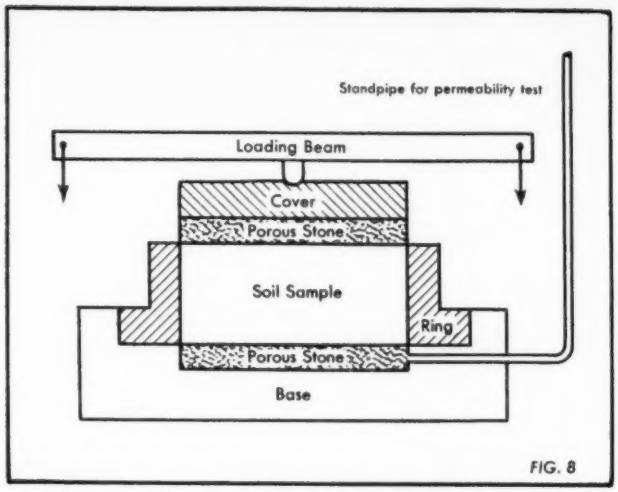
Elasticity

By elasticity is meant that property of a soil which permits it to return to its original dimensions, or nearly so, upon the removal of an applied load. Very few, if any, soils are perfectly elastic but some of them possess elasticity to a degree which may be detrimental, particularly when they are used as subgrades or bases for highways or airports. Problems associated with elasticity are characteristic of certain fine-grained soils; for example, soils which contain large amounts of mica, some diatomaceous earths, or soils which have a high percentage of organic colloids. Recognition of these elastic soils and avoiding or removing them will prevent subsequent damage to the surface structure.

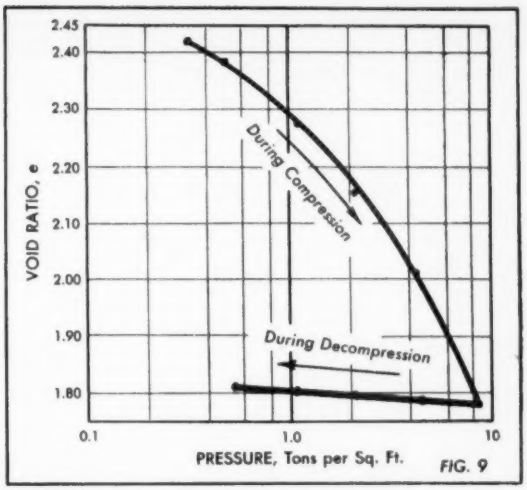
Shearing Resistance

From an engineering standpoint one of the most important basic properties that a soil may have is shearing resistance. Shearing resistance is intimately related to the ability of the soil to withstand load; it is especially important in its relation to such things as the supporting power or stability of a base or subgrade, the allowable pressure which can be used in the design of the foundation of a bridge pier, the stability of the side slope of a highway cut or an embankment, and the lateral pressure which will be exerted upon the walls of an abutment of a bridge.

Two basic types of stresses are of special consequence to us. These are illustrated in Fig. 10, which represents the stress conditions on a plane at some point within a stressed body. Shear stress (τ) is the force per unit of area acting on the plane in a direction parallel to the plane which we are examining; normal stress (σ) is the force per unit of area acting on the plane in a direction which is normal or perpendicular to the plane. The normal stress shown in Fig. 10 is a compressive stress; if it were acting



● **SKETCH of consolidometer for testing soil samples.**



● **CURVES showing void-ratio and pressure relation.**

away from the plane it would be a tensile stress. In soils we are most often concerned with compressive stresses, which simplifies our problem. Our approach is further simplified by limiting ourselves to a two-dimensional stress picture.

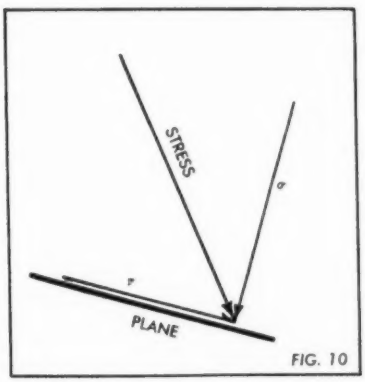
Failures that occur in soil masses generally involve movement or sliding of one portion of the mass with respect to another and are commonly explained in terms of Mohr's theory of failure, which has been found to be applicable to this type of material and to concrete. The general idea involved in Mohr's theory is that failure at a point within a stressed body does not occur because the normal stress on some plane through that point reaches a limiting value, nor because shear stress on some plane reaches a critical value, but rather that failure will occur when there is a *critical combination* of normal stress and shear stress on some plane through the point. Failure at one point in a soil mass may not mean failure of the entire mass, but when failure conditions are reached along a surface or in a zone of considerable extent the mass will fail. Failure of a soil generally then involves movement or sliding or one portion of the mass with respect to another.

Now consider that a set of coordinate axes are established as illustrated in Fig. 11. On the horizontal axis we will plot values of normal stress (compression) with values increasing from 0 at the origin toward the right; on the vertical axis we will plot values of shear stress increasing from 0 at the origin toward the top. Thus the coordinates of a point such as "A" in Fig. 11 (σ, τ) represent the normal stress and the shear stress on some plane through a point in a stressed body. A combination of σ and τ which corresponds to failure may plot at point "B"; this value of σ is designated as "P" (see below) and the corresponding value of τ (at failure) is called "S". If a plot is made of the values of P and S obtained by testing a soil mass a line will be formed which is called "Mohr's Envelope of Rupture." Stress combinations which are represented as being below Mohr's envelope of rupture will not cause failure. Stress combinations which plot on the envelope are, of course, critical ones. Stress combinations which plot above the line are impossible, since failure would already have occurred.

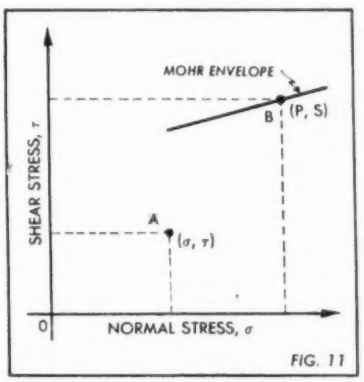
Mohr's envelopes of rupture for two limiting cases involving soils are shown in Fig. 12 (a) and (b). These envelopes are well established by countless laboratory experiments and by experience in the use of these concepts in practical applications.

As indicated in Fig. 12 (a) the Mohr envelope for a dry sand is a straight line passing through the origin; the angle between this straight line and the horizontal axis is ϕ, the "angle of internal friction". The equation for shearing resistance is S = P tan ϕ, where S = shear stress on the plane of failure at the time of failure = shearing resistance; and P = normal stress on the plane of failure at the time of failure. Both S and P are commonly expressed in lbs. per sq ft. or tons per sq. ft.

For a dry sand ϕ, is primarily dependent upon density (void ratio); the lower the void ratio the higher the value of ϕ. Grain shape is also important, as is surface texture; ϕ is higher for a rough, angular sand



● **ACTION of basic types of stresses on plane in soil—shear and pressure.**



● **ILLUSTRATION of Mohr's Envelope of Rupture for specific conditions.**

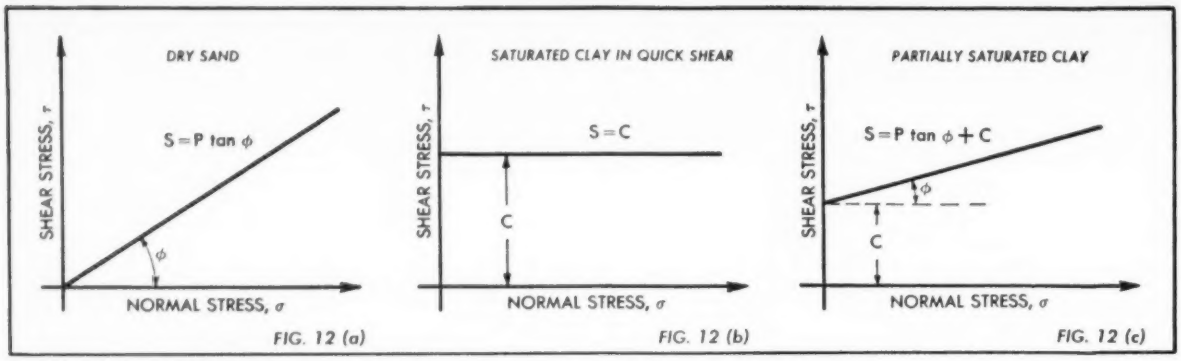


FIG. 12 (a) FIG. 12 (b) FIG. 12 (c)

● **MOHR'S ENVELOPES for dry sand, saturated clay and partially saturated clay. Intercept "C" represents cohesion.**

than for a smooth, rounded sand having the same void ratio. Values of ϕ range from about 30° for a loose, rounded sand to about 45° for dense, angular sand. Gradation of a sand is also important, with ϕ being generally higher for sands which are well graded from coarse to fine.

It should be noted that ϕ is relatively independent of the moisture content for sands; ϕ for a wet sand will be only slightly, if any, less than ϕ for a dry sand, other conditions being the same.

Fig. 12 (b) shows the Mohr envelope for a saturated clay in quick shear to be a straight line parallel to the axis. In other words the shearing resistance for a soil of this type subjected to quick shear is independent of the normal stress and the equation for shearing resistance is: $S = C$.

By "quick shear" is meant that a shear failure is brought about in a very short period of time in a laboratory test. Under such circumstances it is assumed that the loads which are applied to cause failure do not contribute to effective or intergranular pressure; in other words all the added stress is carried by the water in the soil voids. The shearing resistance obtained in a quick test is generally believed to represent the minimum value of strength of a saturated cohesive soil; thus, it is a conservative value for use in preliminary design.

The intercept "C" is frequently called the "cohesion". As previously indicated, the value of C for a dry sand is zero and these soils are frequently called "cohesionless soils"; a saturated clay is a "highly cohesive" soil. The shearing resistance of a clay or other cohesive soil is a complex matter, since it depends on such things as void ratio, speed of shear, moisture content, structure and many others. Very little simplification of the effects of these variables is possible at our present state of knowledge. The shearing strength of most fine-grained soils decreases when their moisture content is increased and is frequently sharply reduced when their natural structure is destroyed.

The Mohr envelope of Fig. 12 (c) is sometimes used to give a somewhat simplified picture of the shearing resistance of soils which do not fall into the two limiting categories which have previously described; it is applicable, for example, to partially saturated clay soils. The equation for shearing resistance is:

$S = C + P \tan \phi$, where the symbols have meanings which have been explained before.

As has been previously stated, the Mohr envelopes of Fig. 12 are determined by laboratory testing. Two principal tests are used for this purpose. These are the direct shear and triaxial compression tests. Basic principles involved in these tests are illustrated in Fig. 13 (a) (b) and (c). A Mohr envelope may be defined, for example, by performing two or more direct shear tests on the same soil but at different normal pressures. The shear stress would then provide the coordinates of one point on the Mohr envelope. The tests would be performed in the laboratory with the soil in the same condition as exists in the field.

In Fig. 13 (c) is shown the unconfined compression test. This test is widely used in soil mechanics laboratories in determining the approximate shearing strength of cohesive soils. The assumption is made that the cohesion (C) is equal to one-half the unconfined compressive strength.

A general knowledge of shear strength is useful to the soil engineer; specific knowledge is indispensable to those who must provide reasonable values to be used in the structural design of foundations, retaining walls, embankments and cut slopes. Some organizations responsible for highways, like the Department of Public Works of the State of New York, maintain modern soil mechanics laboratories and perform the indicated shear tests as a part of routine investigations. The triaxial compression test is being used by the Kansas Highway Department in the thickness design of flexible pavements. Others rely upon experience or empirical approaches for the solution of structural soil problems. In the structural field, wide use is made of a field plate loading test for determining the allowable bearing capacity or soil pressure to be used in the design of shallow foundations.

In the highway and airport field in this country other shear tests are being extensively used in the evaluation of soils which provide support for pavements. Included among these are the California Bearing Ratio test, which is a penetration shear test, and the field plate loading test. Results of these tests do not establish the Mohr envelopes, although they do measure the shearing resistance. Such results are correlated with experience and with extensive research programs to provide the information desired, that is, the thickness of pavement structure which is required under a given set of conditions.

Laboratory Tests

Laboratory tests which are performed as routine operations by agencies in the highway and airport fields include the mechanical analysis and the Atterberg Limits, of which the most commonly used are the liquid and plastic limits. The Atterberg limits are discussed later in more detail. The mechanical

analysis has as its objective the determination of the proportion of particles (grains) of different sizes which are present in a given soil. Performance of the limit tests has a two-fold purpose; in themselves they provide some definite information about physical properties and they serve as the principal basis for placing the soil into one of the groups of the soil classification systems described later. The routine tests have the advantage of being performed upon relatively small disturbed soil samples. Detailed procedures for conducting the tests described herein are well established. The reader is referred to the appropriate publications of the American Association of State Highway Officials and American Society for Testing Materials for the details of standard test procedures.

Preparation of a soil sample for testing is also covered in detail in the publications mentioned. The mechanical analysis is generally performed upon the entire sample, unless particles larger than 3 inches in size are present; the presence of these "boulders" is mentioned and the mechanical analysis is performed upon the remainder of the material. The limit tests are performed upon the portion of the material which is finer than a #40 sieve.

Before beginning the discussion of procedures used in determining grain size it seems desirable briefly to discuss the sieves or "screens" which are used. The sieves are made of wire mesh which has square openings. The coarser sieves are designated by the size (width) of the square opening., thus we may have a 3, 2, 1 and ½-inch sieve, or others. The finer sieves are designated by number—US Standard Sieve No. 40, 80, 100 and so on. The widths of openings which correspond to the sieves commonly used in soil testing are as follows:

US. Standard No.	*Size (width) of opening*
10	2.00 mm.
20	0.84 mm.
40	0.42 mm.
60	0.25 mm.
100	0.149 mm.
200	0.074 mm.

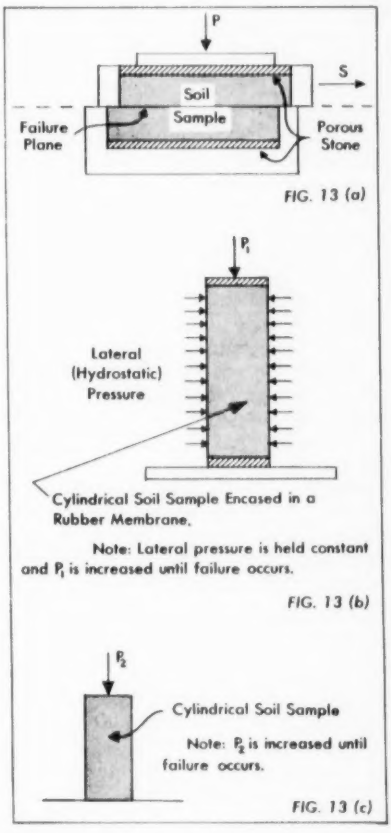
The No. 10 sieve is the dividing line between gravel and sand. Material which is smaller than 3 inches in diameter and will not pass through (that is, is coarser than) a No. 10 sieve is thus "gravel". The size of the No. 200 sieve is 0.074 mm, whereas the dividing line previously established between sand and silt is 0.05 mm. Thus material which is finer than a No. 10 sieve and is coarser than a No. 200 sieve is "sand". Material which passes through the No. 200 sieve may be very fine sand, silt or clay. Therefore the proportion of silt and clay cannot be determined by sieve analysis alone. The No. 200 sieve is the finest that is used.

Two methods of determining the distribution of grain sizes in a soil are in common use. One of these is a combined sieve and hydrometer analysis; which is the method usually preferred in soil mechanics laboratories and the one which must be used if a complete picture is desired of the distribution of grain sizes in a fine-grained soil. (The reader should note that other methods based upon sedimentation may be substituted for the hydrometer method.) The other method is the "wet sieve analysis" which is in wide use among state highway departments.

In the first of these methods a representative sample of soil is selected and divided into two parts by passing it over a No. 10 sieve. The coarse material which is retained on the No. 10 sieve is subjected to a sieve analysis. A portion of the material passing the No. 10 is dispersed and put into suspension in water. Changes in the specific gravity of the suspension with time are then noted by means of a hydrometer; temperature of the suspension is recorded each time a hydrometer reading is taken. The hydrometer analysis is based upon Stokes' Law, which embodies the fact that the rate at which a particle of soil will settle out from a suspension is a function of its size. The larger particles settle out rapidly while the very fine particles require a comparatively long time. As the particles settle out the density or specific gravity of the suspension decreases; this change is the information supplied by the hydrometer reading. Known relationships may then be employed to calculate the percentages of grains of various average diameters remaining in suspension (or which have settled out). In other words, for each of the time intervals specified in the test procedure there may be determined the percentage of the dispersed sample which is finer than (or coarser than) a certain grain size.

After the hydrometer analysis is completed the soil is washed over a No. 200 sieve. Material which is retained on the No. 200 sieve is oven dried and passed over a nest of sieves—usually those listed in the preceding table are used. The results of the sieve analysis and the hydrometer analysis are combined and the final results of the test may be presented in the form of a complete grain-size distribution curve for the soil concerned. In Fig. 14 are shown grain-size distribution curves for four different soils. Curve "A" is that pertaining to a uniform sand; "B" is that of a poorly graded gravelly soil; "C" is a well-graded soil; and "D" is coarse aggregate such as used in concrete.

The meaning of this form of presentation is shown by examination of curve "C". There is no gravel in this soil, since 100% of it is finer than 2 millimeters (No. 10 sieve); the soil contains about 67% sand, since about 33% is finer than 0.05 mm. About 10% of the material falls in the range of clay sizes (less than 0.005 mm). Thus, 23% of the sample is silt. The make-up of this soil then is Gravel 0%, Sand 67%, silt 23%. and Clay 10%.



● **EQUIPMENT for performing direct shear, triaxial compression and unconfined compression tests.**

In many cases the entire grain-size distribution curve is not required; this is particularly true among highway agencies which use the revised Public Roads classification system described later. In such circumstances a wet sieve analysis may be used in which the soil is washed over a nest of sieves of selected sizes. In one such method the soil is washed over the Nos. 10, 40 and 200 sieves. Subsequent calculations show the percentages of material retained on each of these sieves, as well as that which passes the No. 200 sieve. In this method the material passing the No. 200 sieve is frequently called "combined silt and clay." Reliance is placed upon the limit tests to tell whether the material passing the No. 200 sieve has the characteristics of a silt or a clay.

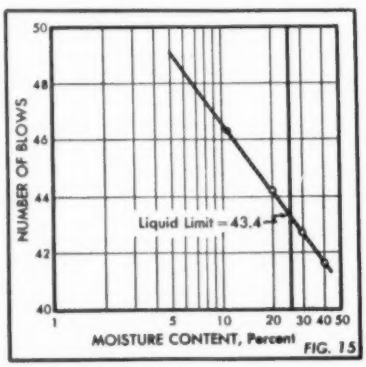
Limit Tests

The Atterberg limits were originally developed by the Swedish soil scientist whose name they bear. In general terms, the liquid limit may be defined as the minimum moisture content at which the soil will flow upon the application of a very small shearing force. In the laboratory the liquid limit is usually determined by means of the mechanical device which is shown in the accompanying illustration. A sample of the soil being examined is mixed with water, placed in a standard manner in the brass cup, and grooved with a special tool. The crank of the device is then turned at a standard rate; each turn of the crank raises the cup from the hard rubber base and then allows it to fall through a distance of one centimeter. The number of blows needed to close the groove over a distance of ½ inch is determined. The moisture content of the sample is then measured. The liquid limit is the moisture content at which the groove will just close upon application of 25 blows. In performing the test it is usually not practicable to establish the exact moisture content which corresponds to 25 blows. Consequently a number of trials are made with the soil at moisture contents both above and below the liquid limit, and the plot of Fig. 15 is prepared. This plot or "flow curve" is a straight line; the moisture content at which the plotted line crosses the 25-blow line is the liquid limit. High values of the liquid limit are associated with soils of high compressibility. In fact the liquid limit may be said to be directly proportional to compressibility.

The plastic limit is defined as the minimum moisture content at which the soil remains in a plastic state. In terms of the laboratory procedure, the plastic limit is rather arbitrarily defined as the lowest moisture content at which the soil can be rolled into a thread ⅛ inch in diameter without breaking or crumbling. If a cohesive soil is wetter than the plastic limit a thread may be rolled to a diameter of less than ⅛ inch before crumbling; if drier, the soil will crumble before this diameter can be reached. When the moisture content is just equal to the plastic limit, a thread can be rolled out by hand to ⅛-inch diameter and then will crumble or break into pieces. Certain soils—for example, clean sands—are non-plastic; that is, no plastic limit can be determined.

The plasticity index (P.I.) of a soil is the numerical difference between the liquid and plastic limits. Thus, the P.I. indicates the range of moisture content over which the soil is in a plastic condition. Sandy soils and most silts have characteristically low P.I. values, while most clay soils have typically high values. Soils which have high plasticity indexes are highly plastic and, generally speaking, are quite compressible. It is also apparent that the P.I. is a measure of cohesiveness, with a high value indicating a high degree of cohesion. The P.I. is inversely proportional to the permeability of the soil; the higher the P.I. the lower the permeability, and vice versa. Soils which do not have a plastic limit, such as cohesionless sands, are reported as having a P.I. of zero. The liquid limit of the soil of Fig. 15 is about 43.4. Assume that the plastic limit of this soil is found to be 18.2. The P.I. then is 43.4 minus 18.2 or 25.2.

The limit tests are most valuable in their relationship to the soil classification systems explained in the next section. Both the mechanical analysis and the P.I. are widely used to control the characteristics of soils which are to be incorporated in roadways or airport runway structures. For example, specifications for sand-clay mixtures which are to be used as bases or surface courses usually contain requirements relative to the grading of the material, the liquid limit and the plasticity index. Experience has shown that strict compliance with the requirements relative to the P.I. is particularly important.



● **CURVE used for the determination of the liquid limit of a soil sample.**

SOIL CLASSIFICATION

Two soil classification systems will be described in this section. These are (1) the revised Public Roads System, which is widely used in highway work; and (2) the Airfield Classification System, which has found its greatest usefulness among engineers dealing with airport problems.

The objective behind the use of either of these classification systems is to be able to predict the engineering behavior of a given soil upon the basis of a few simple tests which are performed upon relatively small disturbed samples. Perhaps their greatest usefulness is in predicting the behavior of soils which are to serve as subgrades. On the basis of the results of the routine tests and their correlation with field experience, a soil may be classified into a group of soils, all of which have similar characteristics and properties. Classification should not be regarded as an end in itself, but rather as a tool to further the engineer's knowledge of soil characteristics and behavior.

In Table 2, which is from a report of a Committee of the Highway Research Board, is shown the bases of the modified Bureau of Public Roads classification system. It will be noticed that there are two very broad groups—"Granular Materials" and "Silt-Clay Materials". There are seven major groups numbered from A-1 through A-7 inclusive, together with a number of suggested subgroups. The A-8 group, which contained the highly organic soils such as peat and muck is not included, since it was felt that no group was needed for these soils because of their ready identification by appearance and odor.

The Group Index is an empirical constant introduced into the classification. The Group Index formula is:

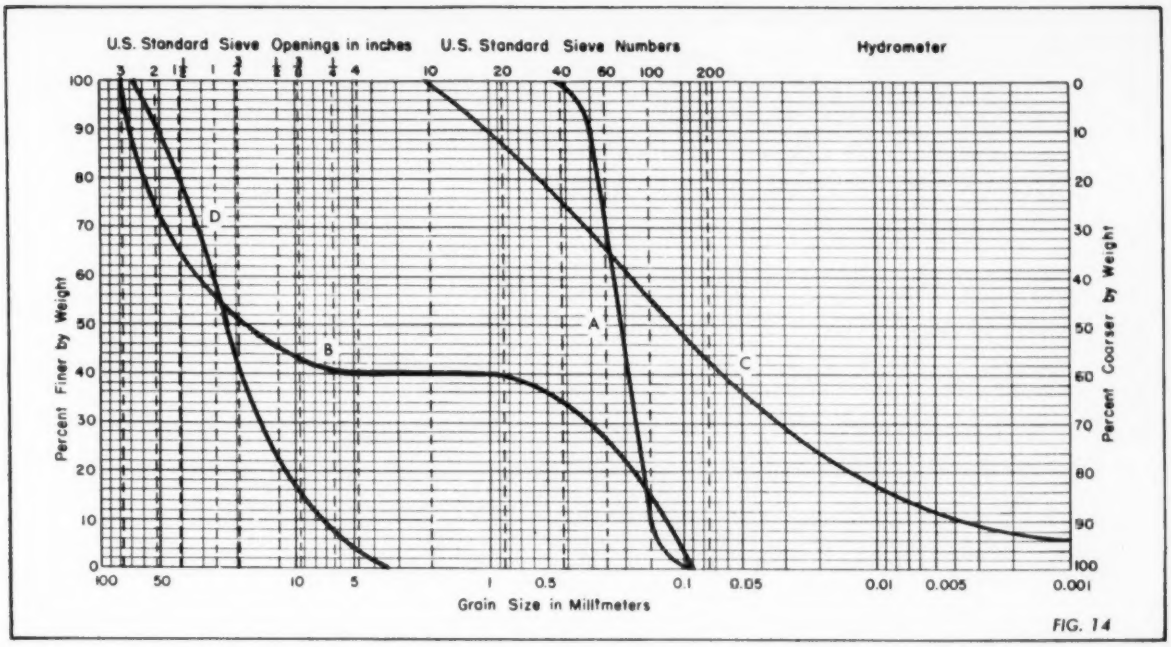


FIG. 14

● **Chart showing grain size distribution curves of samples of various types of soil. These curves are discussed on page 89.**

$GI = 0.2a + 0.005\,a\,c + 0.01\,b\,d$

In which:

a = That portion of percentage passing No. 200 sieve greater than 35 and not exceeding 75, expressed as a positive whole number (1 to 40).

b = That portion of percentage passing No. 200 sieve greater than 15 percent and not exceeding 55 percent, expressed as a positive whole number (1 to 40).

c = That portion of the numerical liquid limit greater than 40 and not exceeding 60, expressed as a positive whole number (1 to 20).

d = That portion of the numerical plasticity index greater than 10 and not exceeding 30, expressed as a positive whole number (1 to 20).

Charts to facilitate the calculation of the Group Index are shown in Fig. 16, page 92.

Fig. 17 shows graphically the

TABLE 2—CLASSIFICATION OF HIGHWAY SUBGRADE MATERIALS

(With Suggested Subgroups)

General Classification....	Granular Materials (35% or less passing No. 200)							Silt-Clay Materials (More than 35% passing No. 200)			
Group Classification.....	A-1		A-3	A-2				A-4	A-5	A-6	A-7
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5, A-7-6
Sieve Analysis, per cent passing:											
No. 10.....	50 max.										
No. 40.....	30 max.	50 max.	51 min.								
No. 200.....	15 max.	25 max.	10 max.	35 max.	35 max.	35 max.	35 max.	36 min.	36 min.	36 min.	36 min.
Characteristics of fraction passing No. 40:											
Liquid limit.....				40 max.	41 min.	40 max.	41 min.	40 max.	41 min.	40 max.	41 min.
Plasticity index.....	6 max.		N.P.	10 max.	10 max.	11 min.	11 min.	10 max.	10 max.	11 min.	11 min.[a]
Group Index [b].....	0		0	0		4 max.		8 max.	12 max.	16 max.	20 max.
Usual Types of Significant Constituent Materials.	Stone Fragments, Fine Gravel, and Sand			Silty or Clayey Gravel and Sand				Silty Soils		Clayey Soils	
General Rating as Subgrade.....	Excellent to Good							Fair to Poor			

Classification Procedure: With required test data available, proceed from left to right on above chart and correct group will be found by process of elimination. The first group from the left into which the test data will fit is the correct classification.

[a] Plasticity index of A-7-5 subgroup is equal to or less than L.L. minus 30. Plasticity index of A-7-6 subgroup is greater than L.L. minus 30 (see Figure 2).

[b] See group index formula and Figure 1 for method of calculation. Group index should be shown in parentheses after group symbol as: A-2-6(3), A-4(5), A-6(12), A-7-5(17), etc.

ranges of liquid limit and plasticity index for the silt-clay groups. It is particularly useful in subdividing the soils in the A-7 group.

The precedure of using the system is quite simple, in fact almost automatic. Table 2 is used in a left-to-right elimination process, and the given soil placed into the first group into which it fits. Use of the system will be illustrated by four specific examples, using soils having the following characteristics, as shown in Table 3.

Soil No. 1.—Calculation of Group Index by formula:

a = 65.3 − 35 = 30

b = 55 − 15 = 40

The value of 65.3 is above critical range—value of "b" can not be more than 40 nor less than 0.

c = 60 − 40 = 20

Same reasoning as for "b".

d = 12.4 − 10 = 2

G.I. = 0.2(30) + 0.005(30) 20 + .01(40)2

= 6 + 3 + 0.8 = 9.8 = 10 (to nearest whole number)

By Chart of Fig. 16: From left hand chart, Read "9"; from right hand chart, Read "1". The sum of these is Group Index, 9 + 1 = 10, as before.

To place the soil in a group, enter Table 2 and use a left-to-right elimination process. This soil can not be A-1, A-2 or A-3 since the percent passing #200 is greater than 35. It cannot be A-4, because the P.I. is more than 8. It cannot be A-5, as the P.I. is more than 10. It cannot be A-6, as the liquid limit is more than 40. Hence it must be an A-7(10).

Soil No. 2.—Group Index by chart (Fig. 16): From left hand chart, Read "2"; from right hand chart, Read "0". G.I. 2 + 0 = 2.

Referring to Table 2 this soil can not be A-1, 2 or 3, since amount passing #200 is more than 35%. It meets the requirements of the A-4 group and thus is A-4(2).

Soil No. 3.—Group Index by chart (Fig. 16): from left hand chart, Read "0"; from right hand chart, Read "0". G.I. = 0 + 0 = 0.

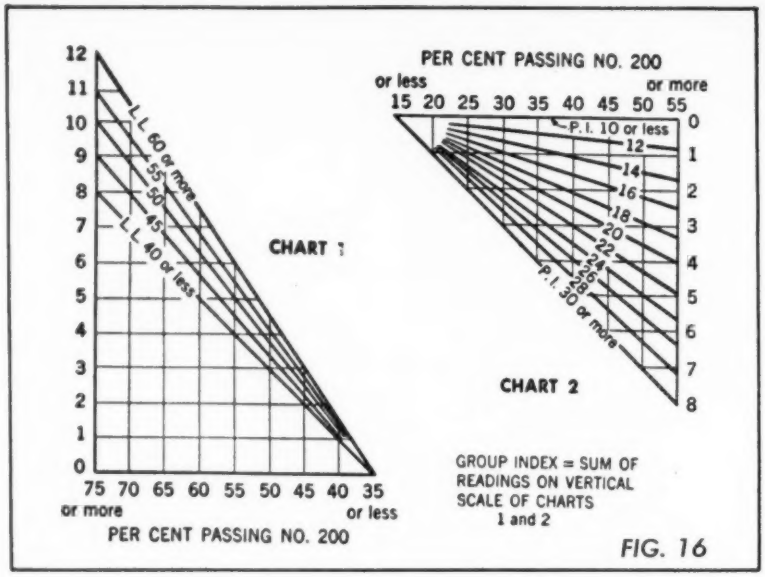


FIG. 16

● CHARTS for determining the Group Index of various soils.

Referring to Table 2, this soil can not be an A-1 or A-3, since the amount passing the No. 200 sieve is excessive. It meets the requirements of an A-2-4 and is designated A-2-4 (0).

Soil No. 4.—Group Index by chart (Fig. 16): From left hand chart, Read "0"; from right hand chart, Read "0". P.I. = 0.

This soil can not be an A-1, since the amount passing the #40 sieve is excessive. It meets the requirements of the next group and is therefore A-3 (0).

Soil Descriptions

The following are brief descriptions of soils which may be contained in each of the groups of the revised Public Roads system. These have been abstracted from the report referred to above.

A-1.—Well-graded mixtures of gravel, sand and non-plastic soil binder. Also includes coarse materials without binder.

A-1-a. — Predominantly stone fragments or gravel, either with or without a well-graded soil-binder.

A-1-b. — Predominantly coarse sand, either with or without a well-graded soil binder.

A-3.—Fine beach or desert blow sand without fines or with a small amount of non-plastic silt.

A-2.—This major group includes a wide variety of materials which are "granular" in character and yet are borderline between groups A-1 and A-3, and the silt-clay materials. These soils can not be classed as A-1 or A-3 because of poor grading or poor binder soil, or both.

A-2-4 and A-2-5.—Binder soil has characteristics of A-4 or A-5 group (silts). For example, fine sand with non-plastic silt content in excess of requirements for A-3.

A-2-6 and A-2-7.—Binder soil has characteristics of A-6 or A-7 group (Plastic clays). For example,

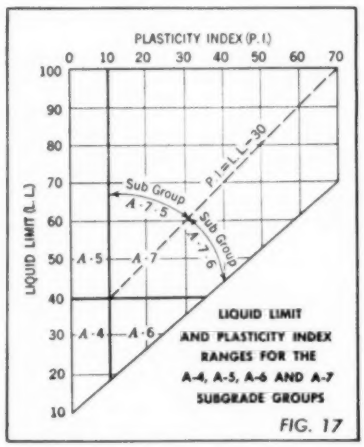


FIG. 17

TABLE 3—CHARACTERISTICS OF SOILS

Soil No.	Sieve Analysis Percent passing, by weight #10	#40	#200	Liquid Limit	Plasticity Index
1	100.0	98.0	65.3	66.7	12.4
2	100.0	86.0	44.0	17.6	5.2
3	100.0	70.2	31.6	27.4	8.1
4	100.0	79.0	1.2	20.8	NP

TABLE 5—CHARACTERISTICS PERTINENT TO ROADS AND AIRFIELDS

Major Divisions (1)	(2)	*Letter* (3)	*Name* (4)	*Value as Foundation When Not Subject to Frost Action* (5)	*Value as Base Directly under Bituminous Pavement* (6)
COARSE GRAINED SOILS *Note 1*	GRAVEL AND GRAVELLY SOILS *Note 3*	GW	Well-graded gravels or gravel-sand mixtures, little or no fines	Excellent	Good
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines	Good to excellent	Poor to fair
		GM d	Silty gravels, gravel-sand-silt mixtures	Good to excellent	Fair to good
		GM u		Good	Poor
		GC	Clayey gravels, gravel-sand-clay mixtures	Good	Poor
	SAND AND SANDY SOILS *Note 4*	SW	Well-graded sands or gravelly sands, little or no fines	Good	Poor
		SP	Poorly graded sands or gravelly sands, little or no fines	Fair to good	Poor to not suitable
		SM d	Silty sands, sand-silt mixtures	Good	Poor
		SM u		Fair to good	Not suitable
		SC	Clayey sands, sand-clay mixtures	Fair to good	Not suitable
FINE GRAINED SOILS *Note 2*	SILTS AND CLAYS LL < 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	Fair to poor	Not suitable
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	Fair to poor	Not suitable
		OL	Organic silts and organic silt-clays of low plasticity	Poor	Not suitable
	SILTS AND CLAYS LL > 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Poor	Not suitable
		CH	Inorganic clays of high plasticity, fat clays	Poor to very poor	Not suitable
		OH	Organic clays of medium to high plasticity, organic silts	Poor to very poor	Not suitable
HIGHLY ORGANIC SOILS		Pt	Peat and other highly organic soils	Not suitable	Not suitable

Notes:

1. Containing more than half of material larger than No. 200 sieve size.
2. Containing more than half of material smaller than No. 200 sieve size.
3. More than half of coarse fraction is larger than No. 4 sieve size.
4. More than half of coarse fraction is smaller than No. 4 sieve size.
5. Column 3, Division of GM, and SM groups into subdivisions of d and u are for roads and airfields only; subdivision is on basis of Atterberg limits; suffix d (e. g., GMd) will be used when the liquid limit is 28 or less and the plasticity index is 6 or less; the suffix u will be used when the liquid limit is greater than 28.
6. Column 5, values are for subgrade and base courses except for base course directly under bituminous pavement.
7. In column 6, the term "excellent" is not used; it has been reserved for base materials consisting of high quality processed crushed stone.

gravel and coarse sand with clay contents in excess of requirements for A-1.

A-4.—Non-plastic or moderately plastic silty soil, frequently having more than 75% passing the No. 200 sieve.

A-5.—Silty soils similar to those of group A-4, except that they are usually of micaceous or diatomaceous character and may be highly elastic.

A-6.—Plastic clay soil frequently having 75% or more passing the No. 200 sieve. Soils of this group have high volume change with change in moisture content.

A-7.—Similar to that of A-6, except that they may be highly elastic as well as subject to high volume change.

A-7-5.—Soils with moderate plasticity indexes in relation to liquid limit.

A-7-6.—Soils with high plasticity indexes in relation to liquid limit. They are apt to undergo extremely high volume changes.

Agencies using this system in day-to-day operations have built up a great reservoir of information about its use and developed both general and specific criteria relating this knowledge to the engineering behavior of soils in each group under different circumstances. Two general examples of this use of the system are presented here.

Development of the group index formula was based, in part, upon these facts. First, that material within group A-1-a, A-1-b, A-2-4, A-2-5, or A-3, when properly drained and compacted under a thickness of pavement structure appropriate for the traffic to be carried, will serve satisfactorily as a subgrade, or can be made satisfactory by the addition of small amounts of natural or artificial binder. Materials falling in the other groups will range in quality as subgrades from the approximate equivalent of good A-2-4 or A-2-5 soils to fair and poor subgrades which require an increased thickness of base course or an extra layer (subbase) to support adequately traffic loads. The system can thus be related in a fairly specific way to require pavement thickness.

The general suitability of soils for embankment construction is indicated in Table 4; this is a second example of the general knowledge associated with the Public Roads system.

TABLE 4—

SOILS FOR EMBANKMENTS

Group	*Suitability for Embankments*
A-1	Excellent
A-2	Excellent to good. Require a little more care in compaction than A-1 soils.
A-3	Good to fair. Frequently can not be compacted by sheepsfoot rollers.
A-4	Fair to poor. Fair for low fills, require careful control of compaction.
A-5	Unsatisfactory (elastic in nature).
A-6, A-7	Poor to very poor. Very difficult to compact.

Approximate Equivalent Groups of Unified Soil Classification System and Public Roads System

Unified System	*Public Roads*	*Unified System*	*Public Roads*
GW	A-1-a	ML	A-4
GP	A-1-a	CL	A-6, A-7-5
GM	A-1-a, A-2-4 or 5	OL	A-4, A-7-5
GC	A-2-6 or 7	MH	A-5
SW	A-1-b	CH	A-7
SP	A-3	OH	A-7
SM	A-1-b, A-2-4 or 5	Pt	None (Formerly A-8)
SC	A-2-6 or 7		

The Unified Classification System

Attention will now be given briefly to the Unified Soil Classification System. This system was adopted for use by the Corps of Engineers and the Bureau of Reclamation in January, 1952. It is based upon the Army Uniform Classification System developed by Arthur Casagrande of Harvard University during World War II.

Basic groups of the system and principal general engineering characteristics of the soils contained in each group as related to roads and airfields are presented in Table 5. The plasticity chart for the classification of fine grained soils is shown in Fig. 18. It is believed that the information contained in the table and figure is self-explanatory and no detailed discussion of the system will be undertaken here.

Information shown in Table 5 is supplemented by a "plasticity chart", which does not appear in this article. One of the principal parts of the chart is the "A-line", which is a straight line having the equation:

$$PI = (L.L. - 20)\ 0.733.$$

Fine-grained soils which plot below the A-line are designated M (silt) or O (organic); above the A-line as C (clay). The chart is also used in delineating coarse-grained soils which contain fines (GM, GC, SM, SC).

Use of the system can best be illustrated by classifying the four soils previously examined.

Soil No. 1: Since about 65% of this soil passes a No. 200 sieve, it must fall into one of the fine-grained soil groups. The plasticity chart tells us that, with a liquid limit of about 67 and a plasticity index of only 12, the soil must be either OH or MH. If the soil contains a large amount of organic material it would be an OH, otherwise MH.

Soil No. 2: Since more than half of this soil is larger than the No. 200 sieve, it belongs in one of the coarse-grained groups. Since all the coarse fraction is finer than a No. 4 sieve, it must be a sand. It will not meet the requirements for an SW or an SP. It may be either an SM or an SC. However, examinations of the plasticity chart indicate that the soil is a borderline case, since the Atterberg limits are above the "A" line with a P.I. between 4 and 7. Therefore, the soil is SM-SC.

Soil No. 3: Using the same reasoning as for Soil No. 2, this soil must be either an SM or SC. Since the Atterberg limits plot above the "A" line and the P.I. is more than 7, it must be an SC.

Soil No. 4: Since this soil contains very little fines, is all finer than a No. 4 sieve, is non-plastic, and is essentially one size, it is an SP.

The above comparisons of soil classifications are summarized below:

Soil. No.	*Revised PR System*	*Unified System*
1	A-7(10)	MH
2	A-4(2)	SM-SC
3	A-2-4(0)	SF
4	A-3(0)	SP

● **LEFT:** With ditcher operating (in background) a motor grader fills trench by blading sand from road surface.

● **BELOW:** Good mixture of clay and sand is basis for procedure. Trencher mixes sand and clay as it digs.

Building Roads with a Ditch Digger

SAND-clay roads have been built for many years. They take advantage of the favorable road building qualities of the two materials. Sand roads are good when wet but give poor support to traffic when dry. The sand also blows away. Clay on the other hand is excellent when dry but slippery and muddy when wet. The proper combination of the two produces a satisfactory road surface.

Usually this type of construction is carried on where the existing soil is predominantly sand or practically all clay. Under these circumstances one or the other of the materials must be hauled to the job and combined with the one already there. In other words, sand is added to clay or clay is added to sand.

In some areas in Texas, and probably other places also, there is a layer of sand on the surface with clay underneath. In its natural state the sand blows to the side of the road, fills the ditches and piles up along the fences. Until a short time ago the maintenance procedure was to blade the sand back into the road and hope for the best.

A recently elected County Commissioner, J. F. Bodine of Colorado City, Texas, had noticed that the areas of road crossed by pipe lines were generally in good condition. To ascertain why this was so he visited a pipeline job and, after a few hours study, came away with the answer. In digging for a pipeline, the trenching machine cuts through the light sandy topsoil and into the heavy clay topsoil, mixing them together as they were brought to the surface. The mixture was approximately 50 percent each of sand and clay—a mixture that would not blow when dry and would not turn into mud when wet.

Equipped with a Cleveland No. 140 Ditcher powered by an International engine and two International powered Austin Western graders, Bodine's crew of six men have rebuilt 9 miles of road in three months and plan to rebuild 40 miles before the end of the year.

The first step in rebuilding a road is the removal of existing fence posts and rolling up the wire that can be re-used when the project is complete. This is the job of crew members not assigned to machines.

Next, the graders blade the sand dunes on each side of the road toward the center. This phase of the operation is finished when the road center is level and the side piles of sand have been removed.

Cutting a ditch five feet deep, 26 inches wide and 12 feet from the centerline, the trencher now throws the spoil toward the center of the road. This places a mixture of sand and clay where the graders can spread it later and also raises the center of the road 24 to 36 inches. When the trencher reaches the end of a section being worked on, it returns on the opposite side, throwing

an equal amount of material toward the center. Occasionally, a third or fourth pass is made by the trencher if more height is necessary for the road.

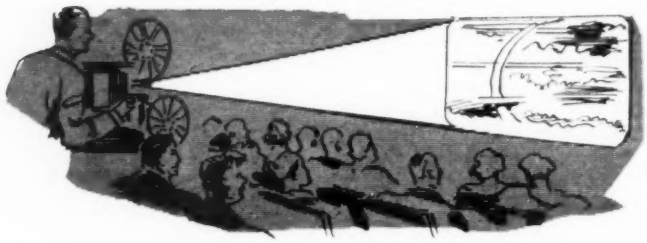
After the trenching, graders begin working the sand left at the side of the road into the empty trenches, packing it by running their wheels over it until the trench is full of well tamped sand, thus forming a sand drain. Routine spreading of the spoil banks tossed up by the trencher makes an excellent road surface of completely mixed sand and clay, raised higher than the surrounding land.

This system will work only when the sand and clay lay in the proper manner but is a very economical method when conditions are right.

Using Moving Pictures for the Promotion of Public Projects

PRIOR to the last election the New Jersey Highway Authority used a motion picture effectively to get out the vote and pass the referendum to authorize pledging the state credit to issue $285,000,000 in bonds to pay for the construction of the Garden State Parkway.

The Authority commissioned On Films, Inc. of Princeton, N. J. to make the film. Scenes were devoted to showing the congestion of present traffic routes and the dangers encountered. Safety features of the new highway were stressed. The method of financing the work was presented by colored charts. Maps were used to show the location of the highway and its effect on the surrounding country.



During the six weeks before Election Day the film was exhibited 1,230 times before audiences in all parts of the State. Service clubs, lodges, religious groups, social organizations, luncheon clubs and others saw it. It was used on television broadcasts by local stations, reaching a cross-section of viewers that is of increasing importance.

It would have been possible to advance all of the arguments in favor of the project in speeches or the written word. But no media other than a sound-color motion picture tells the story so clearly, dramatically and compactly. In almost every public education program, there is the danger of facts being neglected or distorted by the careless speaker or writer. With a sound motion picture the facts are presented exactly as desired. This control of subject matter is important when dealing with political issues. Then again, the motion picture audience is a captive audience, they either look and listen, or they go to sleep. There is nothing else to do.

Now all of this is very fine for a state or large city but what can the small community that wants to promote a new schoolhouse, sewage disposal plant or similar project do to use the motion picture to present the facts to the voters? A picture planned and produced by a commercial organization will cost too much money for the usual city or county, but the job nevertheless can be done at a reasonable cost. Camera clubs exist in practically all communities. If there is no organized club there are almost always a number of amateur motion picture fans. If the political organization will furnish the raw film, a group can usually be found who will be glad to do the photography as a public service. It is not much of a trick to prepare a scenario listing the facts and the proposed scenes to illustrate them. It won't be followed exactly but will serve as a guide. This is a good time to decide on the length of the film which should not run more than about 20 minutes or 800 feet of 16 mm film at sound speed.

Editing may require professional

(Continued on page 123)

● SECTION of Garden State Parkway looking north.

● NEW PARKWAY will help ease this traffic load.

Over 100 at Meeting of So. Calif. Chapter

LOS ANGELES—Dr. John P. Buwalda, Professor of Structural and Engineering Geology, California Institute of Technology, discussed earthquakes—a subject of vital importance to public works officials on the west coast—at the August meeting of the Southern California Chapter.

Over 100 members and guests were in attendance. Dr. Buwalda explained the causes of the earthquakes that occurred in Bakersfield and other California cities last year. He also discussed the possibilities of future occurrences and the responsibilities of public officials and constructors with regard to eliminating building hazards and thus offering the public a greater protection against earthquakes.

(*Continued on page* 104)

70 PERSONS FROM 27 STATES, HAWAII AND D.C. TO TAKE PART IN 1953 CONGRESS PROGRAM

Arrangements Now Virtually Complete for Annual APWA Congress to be Held in New Orleans October 26th to 29th

CHICAGO — Arrangements are now virtually complete for the 1953 Public Works Congress to be held in New Orleans October 26-29. Registration is expected to reach an all-time high with over 1,000 persons in attendance. More than 60 leading manufacturers of all types of public works equipment will display their products in the Municipal Auditorium in this beautiful gulf-port city. An outstanding program has been arranged covering all aspects of public works activities. Some 70 persons, from 27 states, Hawaii and the District of Columbia will participate in the program.

"Composting As A Method of Garbage Disposal," is a symposium scheduled for Tuesday morning, October 27. John R. Snell, Head of Department of Civil Engineering, Michigan State College, East Lansing, Michigan, will discuss "Composting Processes"; Dr. M. S. Andrews of the U. S. Department of Agriculture, Beltsville, Maryland, will discuss the "Economics Of Composting." Another speaker, yet to be announced, will discuss "Operational Problems." Carl Schneider, Consulting Engineer, New Orleans, La., will moderate the discussion of this timely subject.

Intergovernmental Relations

William G. Willis, Director, Institute of Local Government, University of Pittsburgh, Pittsburgh, Pa., will moderate the second symposium on "Intergovernmental Relations In Public Works" on Wednesday afternoon, October 28. This subject will be presented by Norman H. Hebden, Project Director, Highway Research Board who will discuss the subject as it relates to "Streets and Highways." William D. Anderson, General Manager, Campbell and Newton County Sanitation District No. 1, Newport, Kentucky, will discuss the intergovernmental aspects of "Sewage Treatment", and Samuel S. Baxter, Commissioner of Water, Philadelphia, Pa., will discuss this subject as it relates to "Water Supply and Distribution" to complete the symposium.

Performance Budgeting

The third symposium to be featured on the 1953 Congress Pro-

H. P. Long Bridge on Old Spanish Trail to New Orleans

THIS $13,000,000 railroad and vehicular toll-free bridge is the finest over the Mississippi. It is 4.78 miles long and its central pier from the bottom of its foundation 170 feet below mean Gulf level to the top of the superstructure is 409 feet high. Maybe you can ride across it. Highway U. S. 90, the Old Spanish Trail, passes over this bridge to the west and it is an important rail outlet to and from the western states.

gram is scheduled for Thursday morning, October 29. This symposium on "Performance Budgeting In Public Works" will be moderated by Robert K. Sawyer, Managing Director, Philadelphia, Pa. Richard Gallagher, Director of Public Works, San Diego, California, will discuss, "Work Units" and J. H. Gould, Director of Public Works, Richmond, Virginia, will discuss "Work Programs." The problems and procedures relating to "Budget Preparation and Control" will be discussed by Charles L. Seamann, Certified Public Accountant, and Consultant to the City of New Orleans.

What's Your Question?

Six "What's Your Question" sessions have been scheduled to run concurrently Tuesday afternoon and again on Wednesday morning, October 27 and 28. The table, at these sessions, will be staffed by the following persons who will serve as consultants at these sessions and answer questions presented by those in attendance.

Tuesday Afternoon

STREET DESIGN AND CONSTRUCTION —H. F. Clemmer, Engr. of Materials and Standards, Engr. Dept., Washington, D. C.—(Low Cost Pavements)—Chairman. Leo F. Flotron, Engr. of Highways, Dayton, Ohio. (Surface Drainage Structures). A. A. Anderson, Chief Highway Consultant; Portland (Concrete Pavements) Cement Assoc., Chicago, Ill. Ben R. Paris, Asst. General Supt. Bureau of Street (Bituminous Pavements) Maintenance, Dept. of Public Works, Los Angeles, California.

PERSONNEL ADMINISTRATION —Robert G. Sarvis, Director of Public Works, Cincinnati, Ohio. (In-Service-Training)—Chairman. William W. Shaw, Director of Personnel, New Orleans, La., (Job Specifications and Pay Scales). Charles W. Terry, Personnel Director State of Alabama, Montgomery, Alabama. (Recruiting and Indoctrination). E. B. Shultz, Chief Personnel Relations Branch, Tennessee Valley Authority, Knoxville, Tennessee. (Employee Relations).

REFUSE DISPOSAL — Casimir A. Rogus, Director of Engineering, Dept. of Sanitation, New York, New York. (Incineration and Salvage)—Chairman. Walter Bonnet, Engineer-Civil, Corps of Engineers, U. S. Army, Washington, D. C. (Sanitary Land Fill). The speaker on swine feeding will be announced later. Earl W. Deering, Commissioner, Division of Refuse Collection, Dept. of Streets and Sewers, St. Louis, Missouri. (Grinding).

PUBLIC WORKS FINANCING —Milton Rosen, Commissioner of Finance, St. Paul, Minn. (General Tax Levy) —Chairman. John E. Dever, City Manager, Two Rivers, Wisconsin. (Special Assessments). Joseph F. Clark, Executive Director, Municipal Finance Officers' Association, Chicago, Illinois. (Borrowed Funds). E. L. Filby, Consulting Engineer, Black and Veatch, Kansas City, Missouri. (Service Charges).

PUBLIC RELATIONS — The chairman will be announced later; he will discuss Reports. Hoite Agey, Director of Publicity, Miami, Florida. (Visual Aids). Reed McKinley, Director of Public Works, Kansas City, Missouri. (Employee Education). Gerald P. Caffrey, Coordinator, Radio and Publications, Milwaukee, Wisconsin. (Radio, TV, and the Press).

SUBDIVISION DEVELOPMENTS — Albert C. White, Assistant Director, Public Works, Richmond, California. (Planning and Programming of Improvements) — Chairman. Kenneth K. King, Director of Public Works, Phoenix, Arizona. (Financing of Improvements). Harlan Mathews, Director, Division of State Planning, Tennessee State Planning Commission, Nashville, Tennessee. (Minimum Standards). The speaker on Controls and Enforcement will be named later.

Wednesday Morning

STREET MAINTENANCE AND REPAIR —George E. Martin, Highway Consultant, Public Works Magazine.

(Continued on page 102)

Make Your New Orleans Hotel Reservations Without Delay

The APWA has been allotted several hundred rooms in six top hotels. Requests for reservations should be addressed to: Chairman of the Housing Committee, 1953 Public Works Congress and Equipment Show, Room 415 City Hall Annex, New Orleans 12, Louisiana.

For further details and rates write to the APWA Headquarters, 1313 East 60th Street, Chicago 37, Illinois.

THE WHOLESALER'S TEAM

All through his life, the average American learns the value of team play. In his formative years, he finds that touchdown plays are those in which every man carries out his assignment perfectly.

His military experience proves that his very life depends upon the men on either side of him.

And, in business, he finds that success is the result of a carefully integrated team.

So it is with your wholesaler. His business philosophy is to serve people like yourself. To answer your demands, he looks for cooperative people who will balance each other.

He has salesmen and countermen who know the products they are handling. They supply information as to a product's abilities or limitations. They provide hints as to new techniques, conservation of materials, and labor-saving methods. To their customers, the salesmen and countermen are really the wholesaler.

And, behind the scenes, the wholesaler has a competent warehouseman. This man pushes orders through quickly and knows where he can lay his hands on any item at any time.

Other people are on the wholesaler's team, too. His purchasing agent keeps tab on the field, buys up-to-the-minute materials, keeps a constant stock inventory. His credit men, his billing people, and his typists are all important cogs in the machine.

The wholesaler? He keeps his finger on the pulse of the industry. Often, he performs the functions of the people described above. He personifies his team and its service to you.

We at Wolverine Tube Division are proud to be on the wholesaler's side. That's why we tell you that for good service and the best of materials (including of course Wolverine copper tube) to "buy from your wholesaler".

WOLVERINE TUBE DIVISION
of Calumet & Hecla, Inc., *Manufacturers of Quality-Controlled Tubing,* 1451 Central Avenue, Detroit 9, Michigan. Plants in Detroit, Mich., and Decatur, Ala.

Washington news

Presented in cooperation with the American Public Works Association and through the courtesy of the Washington Office of the American Municipal Association.

MUNICIPALITIES throughout the nation spent $31 million for water pollution control projects during the first quarter of 1953, according to US Public Health Service data. Contracts were awarded for 119 municipal sewage treatment projects designed to keep sewage wastes out of rivers, harbors, lakes and waterways. Of these, 61 were for construction of new sewage treatment plants, 48 for enlargement or improvement of existing plants and 10 for construction of interceptor sewers. Projects, by major drainage basins were:

Drainage Basin	*Projects*
Northeast	1
North Atlantic	9
Southeast	11
Tennessee	1
Ohio	14
Lake Erie	3
Western Great Lakes	3
Upper Mississippi	13
Missouri	10
Southwest, Lower Mo.	10
Western Gulf	21
Colorado	2
Great Basin	3
California	11
Pacific Northwest	7
Total	119

Cement Supply to Improve

At a July 30 meeting in Washington between the representatives of the cement industry and officials of the National Production Authority, Dept. of Com., it was stated that cement supplies should improve.

Pointing to an expansion of approximately 10% in production capacity since the defense production program was initiated in 1950, the conferees stated that the industry was capable of meeting this year's cement needs. Temporary shortages should not crop up any longer and public construction backlogs are expected to be filled shortly.

More Critical Materials

Fourth quarter 1953 metal allotments to defense projects will be down, thus allowing more materials for public construction needs. Here are the allotments for fourth quarter 1953 as compared to third quarter 1953: Steel, fourth quarter 1.8 million tons against 2.3 million tons for the third quarter; copper 217.5 million pounds against 243.7 million; aluminum 203.6 million pounds against 223.9 million. Fourth quarter steel allotments are cut down about 20%, other metals about 10%.

New Toll Road Authorities

So far during 1953 seven states have created toll road authorities, while other states have authorized extension of existing toll routes. States creating new authorities are: Florida, Illinois, Kansas, Michigan, Nebraska, Texas and Wisconsin. In all of these states the law provides that construction bonds will be paid from tolls charged for use of the roads. The bonds are not deemed to be debts of the respective states but rather of the Authorities.

In addition, the Connecticut Highway Commissioner has been authorized to build a toll expressway from the New York to the Rhode Island line. In New Hampshire, a toll road is authorized across the southeastern corner of the state, with a second toll road approved for central New Hampshire. North Carolina okayed the Carolina-Virginia Turnpike Authority to build a toll coastal road in that state. In Oklahoma, the voters will hold a referendum on whether or not to authorize extension of the Tulsa-Oklahoma City toll road from Oklahoma City to Wichita Falls, Texas, and Wichita, Kansas, and from Tulsa to Joplin, Missouri.

California, Missouri, New Mexico Rhode Island and Washington legislatures turned down toll road authority proposals.

Now's the time to mail this month's Readers' Service card.

1953 Congress

(Continued from page 98)

New York, N. Y., (Patching). Roy W. McLeese, City Engineer, Salt Lake City, Utah. (Drainage Structure Maintenance) — Chairman. Wesley A. Beck, Supt. of Streets, Tulsa, Oklahoma. (Pavement Cuts and Backfilling). Arthur W. Tews, City Engineer, Duluth, Minnesota. (Seal Coating and Resurfacing).

REFUSE COLLECTION — James S. Devlin, Director, Dept. of Public Works, Pittsburgh, Pa., (Preparation of Refuse and Collection Methods)—Chairman. Stafford W. Graydon, Sanitary Engineer, Atlanta, Georgia. (Planning of Collection Operations). Ralph C. Graham, Supt. of Construction and Public Works, Davenport, Iowa. (Refuse Collection Equipment). Philip E. Shaynem, Shane Brothers, Inc., Washington, D. C. (Contract and Private Collection).

PARKING FACILITIES AND TRAFFIC CONTROLS — Allan H. Rogers, Supt. of Public Works, Garden City, N. Y. (Off-Street Parking Facilities)—Chairman. Marvin L. Davis, Director of Public Service, Akron, Ohio. (Street Parking Regulations). Robert A. Mitchell, Chief Traffic Eng., Div., Gannett, Fleming, Corddry, & Carpenter, Inc., Harrisburg, Pa. (Traffic Control, Devices and Regulations). D. P. DeBord, Planning Engineer, Dept. of Public Improvements, Omaha, Nebraska. (Zoning Requirements).

DRAINAGE — George R. Thompson, City Engineer, Detroit, Michigan. (Storm Water Drainage)—Chairman. Robert Usher Andrews, Engineer in Charge Sanitary Sewer Division, Dept. of Public Works, Fort Worth, Texas. (Sanitary Sewers). Ray Blessing, Commissioner of Streets and Sewers, Kansas City, Mo. (Sewer Maintenance). Kenneth V. Hill, Partner, Greeley and Hansen, Chicago, Ill. (Sewage Treatment).

EQUIPMENT MANAGEMENT — Frederick W. Crane, Comm. of Public Works, Buffalo, N. Y. (Equipment Maintenance)—Chairman. Adolph P. Rasmussen, Mechanical Engineer, Chicago Park District, Chicago, Ill. (Specifications and Procurement). T. J. O'Leary, Supt. of Sanitation, Dept. of Public Works, Boston, Mass. (Rental of Equipment). Richard F. McBean, Supt. Div. of Automotive Equipment, City and County of Honolulu, Honolulu, Hawaii. (Records).

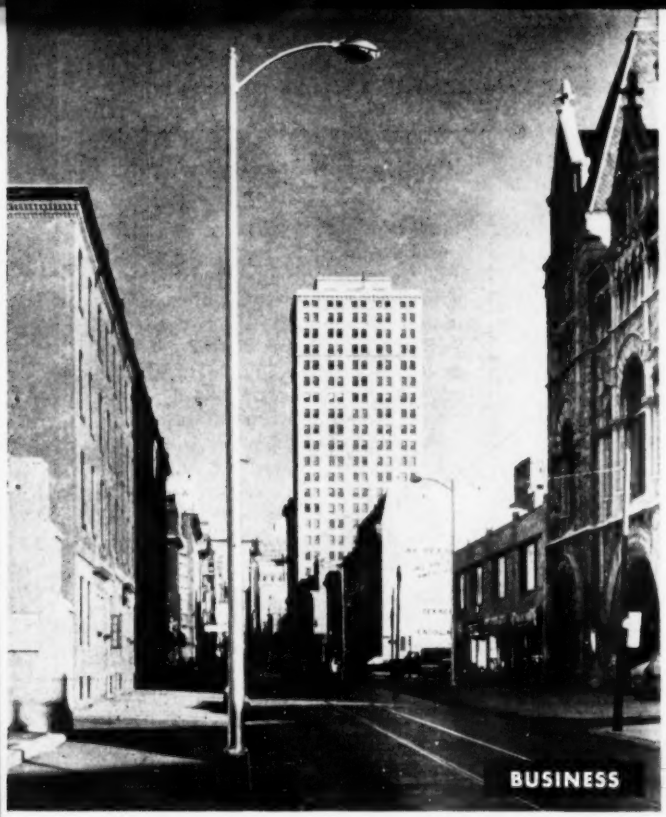
STREET SANITATION — L. D. Merrill, Supt. of Streets and Garbage, Birmingham, Ala. (Street Cleaning) —Chairman. George J. Maher, Director Public Works Dept., Lewiston, Maine. (Snow and Ice Control). James J. Reilly, Executive Director, Mayor Kennelly's Committee for a Cleaner Chicago, Chicago, Ill. Francis Blake, Comm. of Streets, Kansas City, Kansas. (Equipment).

• • •

New APWA Chapter Soon To Be Formed in Wisconsin

WEST ALLIS, WIS.—Peter Burbach, City Engineer of West Allis, Wisconsin and the Association's Chairman in that state, reports that over twenty-five members have signed petitions for the establishment of a Wisconsin Chapter of APWA. All persons directly or indirectly interested in public works activities, in that state, who wish to become charter members of the pro-

(Continued on page 104)



MONOTUBE POLES

. . . best for every lighting need

Continuous-tapered *Monotube Poles* are available in a broad range of standard designs and sizes to meet definite requirements in all types of thoroughfare lighting. And, with *Monotubes,* you gain the extra benefit of cold-rolled strength, outstanding appearance and unmatched experience in modern pole construction and installation. Why not write for specific data on your requirements or ask for catalog. The Union Metal Mfg. Co., Canton 5, Ohio.

Monotube Lighting Poles **UNION METAL**

So. Calif. Chapter

(Continued from page 97)

Max Bookman, Engineer-In-Charge of the So. California Office of the State Division of Water Resources, also took part in the program and discussed the rapid rate of population growth in that area and the problems of an efficient, economical and plentiful water supply necessary to sustain this growth. M. L. Clopton, a private attorney specializing in labor matters, was the third speaker on the program. Mr. Clopton presented a resume of the labor legislation introduced at the last session of the state legislature and also discussed the more important information needed to prepare an effective defense for the employers in cases involving accidents of employees.

• • •

MOVIE OF THE MONTH

The United States Public Health Service in 1951 produced an excellent film telling the story of how one town added fluoride to its water supply to reduce tooth decay. The title of the film is—"A Drop In The Bucket". It is available in both black and white and in color, and is a 13 minute sound film. Copies can be purchased from: Government Films Department, United World Films, Inc., 1445 Park Ave., New York 29, New York. White and black prints are priced at $17.67 per copy, color prints are $66.79 per copy. This film may also be borrowed from State Health Departments in some states.

• • •

New APWA Chapter

(Continued from page 102)

posed chapter should contact City Engineer Burbach without delay. Plans are now being made for an organizational meeting to be held in the near future.

Fifteen local chapters have already been organized to further promote the objective of the Association. The newly established Iowa Chapter—the latest to be officially approved by the Board of Directors—will receive its charter and elect its first slate of officers at a meeting to be held next month.

Write for Full Details about APWA Membership Today

Each month special news items are included in this column to acquaint our readers with the activities and nature of services rendered by the APWA. Supplemental information concerning items appearing in this column is presented in the Association's Newsletter. Membership is only $10. a year. Find out about its many advantages by writing to the Executive Director, 1313 East 60th Street, Chicago 37, Illinois.

• • •

Cost of Laying Water Pipe in Elmira, N. Y.

The Elmira, N. Y., Water Board, John G. Copley, General Manager, gives the amount of pipe laid in 1952 and the cost per foot in the 1952 annual report, as follows: 6-inch, 8451 ft. at $3.37 per ft.; 8-inch, 2262 ft. at $5.21 per ft.; 10-inch, 1967 ft. at $5.33 per ft.; and 12-inch, 348 ft. at $13.24 per ft.

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Concentration of Radioisotopes by Activated Sludge

A study on the subject by the Sanitary Engineering Research Project of the University of California has been reported on (Progress Report No. 2). The following are the conclusions presented in the report:

1. The removal of phosphorus 32, strontium 89, and iodine 131 by activated sludge may vary within wide limits, depending primarily upon the carrier concentration, but also on the biochemical system employed for its concentration.

2. In all instances of comparable substrate composition, removals of the radioisotopes in the batch studies exceeded those obtained under equilibrium conditions in the continuous flow pilot plant studies. This difference is due to the isotopic exchange resulting when a biological system, not previously exposed to a radioelement, is employed in a batch type study.

3. In the municipal treatment plant receiving a waste containing transient concentrations of one or more of the three isotopes studied, slightly greater removals will result at *high* aeration solids concentrations. This relationship, as noted above, is due to the greater exchange capacity of the larger quantity of sludge solids. However, hydraulic dilution within the aeration and settling tanks contributes far more toward the reduction in concentration in passage through the plant than does isotopic dilution.

4. In the industrial treatment plant receiving a waste containing a more nearly constant concentration of radioisotopes, greater removals will result at *low* sludge solids concentrations. The only means by which removal from the biological system is actually brought about is through the wasting of activated sludge solids. Since, for a waste of constant BOD, biological growth is greatest at low sludge solids concentrations, it must be concluded that a system carrying a low conentration of aeration solids will achieve the greatest uptake efficiency.

5. Complexing agents, such as sodium hexametaphosphate and ethylene diamine tetra acetic acid, may be expected to reduce the uptake of strontium 89 and, to a lesser extent, that of iodine 131. The degree of reduction in uptake efficiency in the case of strontium was related to the concentration of complexing agent and the presence of calcium and magnesium.

• • •

Use of Bug Deflectors Restricted

Opaque bug deflectors mounted on the hood of a vehicle create a blind spot in front of the driver, particularly at night, and motor vehicle administrators are considering restricting their use on the basis that they are an accident hazard due to hindrance of vision.

They have been ruled in New Jersey as being illegal unless completely transparent and not larger than 7 in. long and 4 in. high, while in Connecticut deflectors are not allowed on any vehicle. The Committee of Engineering and Inspection of the American Association of Motor Vehicle Administrators has recommended that the administrator's organization go on record in favor of restrictions on use of the deflectors similar to those imposed by New Jersey. From Motor Vehicle Inspection Bulletin via Highway Research Abstracts.

Trickling Filter Treats Domestic Sewage and Radioactive Waste

A. L. BILADEAU

Sanitary Engineer, AEC.

THE Central Facilities Area of the National Reactor Testing Station in Idaho needed both a modern sewage treatment plant and a wastes disposal system for a "hot" laundry handling contaminated protective clothing. After encouraging results from a pilot plant, it was decided to construct a combination treatment unit, using a standard trickling filter. Horner & Shifren, Consulting Engineers of St. Louis, Missouri, were engaged to design the plant. Design followed closely normal standards, but special provisions were made for: (1) Precise measurement of flows of both laundry waste and sewage; (2) close control of flow rates through the filter; (3) recirculation through the filter to maintain a constant flow loading; and (4) varying the conditions of operation to find the methods best suited to the removal of radioactivity.

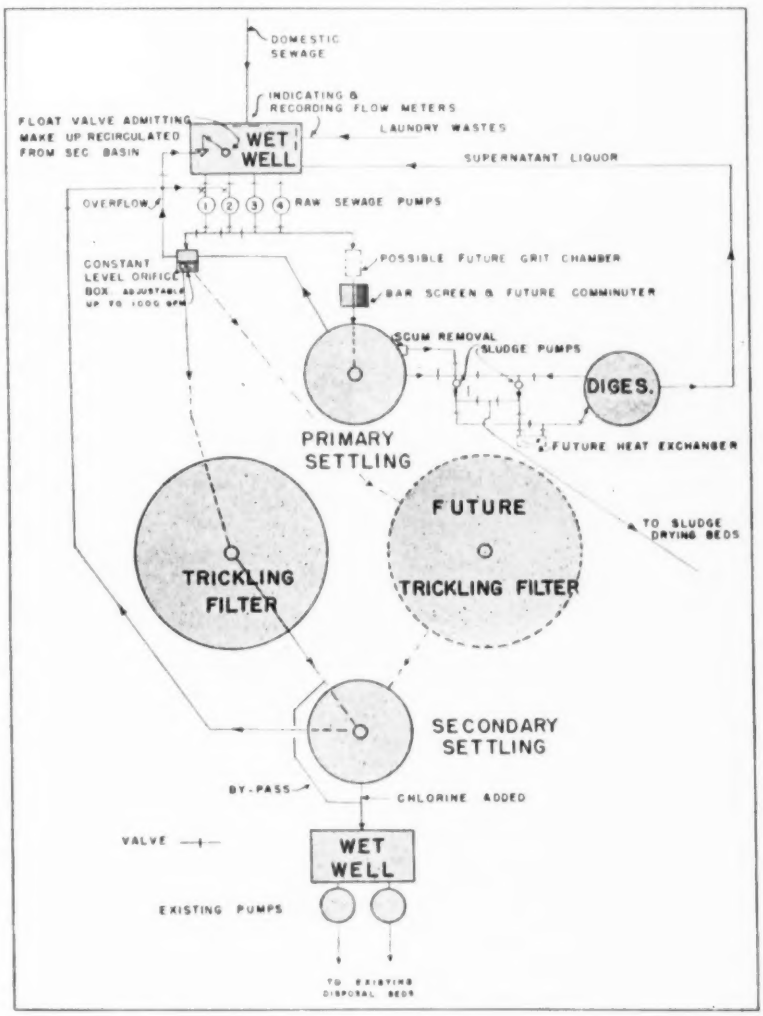
The domestic sewage and the contaminated laundry waste enter the plant by separate lines. Each is measured separately on recording flow meters, using Kennison nozzles, before discharge to a common wet well. From the wet well, the sewage is pumped through bar screens to the primary settling tank. The effluent from the primary clarifier flows by gravity to a constant-level sump where sludge from the secondary clarifier is added. Calibrated orifices permit maintaining any desired flow to the filter. Excess sludge is discharged to the wet well. Filter effluent flows by gravity to the secondary clarifier, which discharges into a wet well which serves as a chlorine contact tank. From this wet well, the final effluent is pumped to a subsurface disposal field.

Settled secondary sludge flows by gravity either to the influent wet well or to a recirculation pump which lifts it to the constant-level box. A float-controlled butterfly valve in the wet well determines which path it will take. This valve passes make-up flow from the secondary clarifier to the wet well during periods of low flow so that the pumps will always have sufficient sewage to discharge at full capacity. Primary sludge is discharged to the digester by a timer that can be set for any desired pumping cycle. Scum from the primary clarifier is discharged to a scum well, and removed by manually valving and operating a sludge pump.

The Trickling Filter

The design of the trickling filter is normal for a standard rate installation, using 2-inch to 3-inch media, underdrains for drainage and ventilation, and a volumetric dosing rate of about 6 mgad. A feature of the plant is the use of continuous recirculation. Research and tests indicated that, while a loading of the contaminated waste and domestic sewage gave good results at 1 mgad, recirculation ratios of 5 to 1 and above gave the most satisfactory overall absorption of radioactivity. Recirculation ratios of 5, 10 and 15 were tried, but it was found that 5 to 1 produced satisfactory results, and this value of R was used.

Studies also indicated that return of solids to the filter was beneficial. Since the accumulation of such



● **LAYOUT of sewage treatment plant for handling both domestic sewage and laundry wastes which are contaminated with radioactivity at an AEC installation.**

solids in the filter cannot exceed certain limits, the filter must unload from time to time. During such periods radioactive materials may be discharged in some amount. To eliminate excessive carryover, the secondary settling tank is designed larger than would be normal in domestic sewage treatment.

The digester provides a capacity of 5 cu. ft. per capita—also larger than normal. The extra capacity was deemed desirable to provide extra time for radioactive decay before placing the sludge on the drying beds.

The need for a retention tank for the laundry waste was studied carefully. The laundry operates 8 hours a day and 5 days a week; therefore, there is no weekend flow. Though dispersion of the 8-hour flow over a 24-hour period seemed desirable, it was decided to omit the holding tank, but to provide in design for its later installation if necessary.

There are three non-clog type sewage pumps which are controlled by floats in the wet well. Normal operation will be to run one of the pumps continuously, adding enough make-up water to satisfy the capacity of the pump. If flow increases beyond the capacity of this pump (normally the No. 3 pump) the other pumps come into operation. Any pump can be set to function in any float switch position. Pumps Nos. 1 and 2 are so piped and valved that either or both may be used for recirculation, under any of several conditions. Also, the plant can be operated without any recirculation. Most units, excepting the primary clarifier, can be bypassed as can the entire plant. In this case, an existing septic tank would be used.

The ratio of domestic sewage to laundry waste is about 10 to 1, but the amount of radioactive elements that may be present in the laundry waste is not known accurately. The amount of contamination reaching the plant from the laundry will be partially controlled by monitoring the waste at the laundry and by discarding garments that are grossly contaminated. The contaminants are expected to be mainly mixed fission products.

The laundry waste inlet line will be monitored, as will the final basin effluent line and the digested sludge when and as drawn. Special operating records will be maintained which will indicate the percentage removal of radioactivity.

This article is based on a report by Mr. Biladeau of the Idaho Operations Office, AEC.

• • •

Thawing an Elevated Tank Riser

The problem posed by the freezing of a 6-foot core of ice 42 feet high in the riser pipe of the elevated backwash tank at the Moline waterworks was described in Illinois "Over the Spillway" by E. A. Anderson. Several weeks of below-zero weather preceded this freeze-up. During this time the backwash tank had been periodically surged and drained to keep the water in motion. During a night shift this surging had been interrupted, and by morning the tank was sealed off by ice in the riser. The manhole in the base of the riser was removed and two kerosene jet heaters were directed into the opening. At the same time some 1200 pounds of salt was dumped in the top of the tank. It took 36 hours of heating to loosen the ice. Just before it was felt that this mass of ice would break loose, the manhole was replaced in the base and the riser filled with water to cushion the fall. The work was effective.

Outline of Regulations for SUBDIVISION STANDARDS

A MODEL set of standards, especially applicable to Tennessee communities, has been prepared by the Tennessee State Planning Commission and is available as Publication 248 from the Commission. The following data are abstracted from this publication.

Plat Approval—Two separate steps are required by the standards for plat approval by a Planning Commission. A preliminary sketch, on a scale of 100 ft. to an inch, should show the name and location of the subdivision and the name and address of the owners and of the engineer. It should be dated and show a north point and a graphic scale. Existing and platted property lines, streets, buildings, water courses, sewers, railroads, water mains and public easements should be shown; also the proposed layouts for such utilities as water, sewers and electricity.

Contours should be at not more than 5-ft. intervals. Names, locations, widths and other data in regard to streets, alleys, easements, parks and open spaces should be indicated.

The final plat map should have the same scale as the preliminary sketch and should be on sheets not larger than 22 ins. by 34 ins., with an index sheet where indicated. The original and at least 3 black and white prints are required for approval. The drawings should show lines of all streets and roads, alleys, lots, buildings, setbacks and areas dedicated to public use; also lots numbered in numerical order, house numbers and restrictions.

Sufficient data should be included to determine readily and reproduce on the ground the location, bearing and length of every street, lot, boundary, block and building line, whether curved or straight. Dimensions must be shown to the nearest one-hundredth of a foot, and angles to the nearest minute. Monuments should be located and described, and the names of adjoining subdivisions and streets and the location and ownership of adjoining unsubdivided property shown. Date and other information as name of owner and engineer and addresses are necessary, as is a key map. Certifications must include a statement that the applicant is the land owner and dedicates the streets, rights-of-way and public sites; a statement by the engineer or surveyor as to accuracy of the survey; approval by the health officer when individual water or sewerage systems are to be installed; and approval by the city or county engineer.

Standards of Design

Streets—The location and width of all streets must conform to the official major thoroughfare plan or its equivalent. The proposed street system must extend existing streets at the same or greater width, but never less than the required minimum width. Arterial streets and highways should be not less than 80 ft. wide; collector streets 60 ft.; minor residential, dead end and marginal access streets 50 ft. Alleys must be at least 20 ft. wide.

Grades on major streets must not exceed 7 percent and on other streets 10 percent. On streets 60 ft. or more wide, the center line radius of horizontal curvature must be not less than 300 ft.; on other streets it may be 100 ft. All changes in grade must be connected by vertical curves having a minimum length in feet 15 times the algebraic difference of the two grades for major streets; for other streets the minimum is half as great. Thus the length of vertical curve for a major street having a 7 percent grade joining a 7 percent grade will be 15 (7 + 7) = 210 ft. Intersections must be as near-

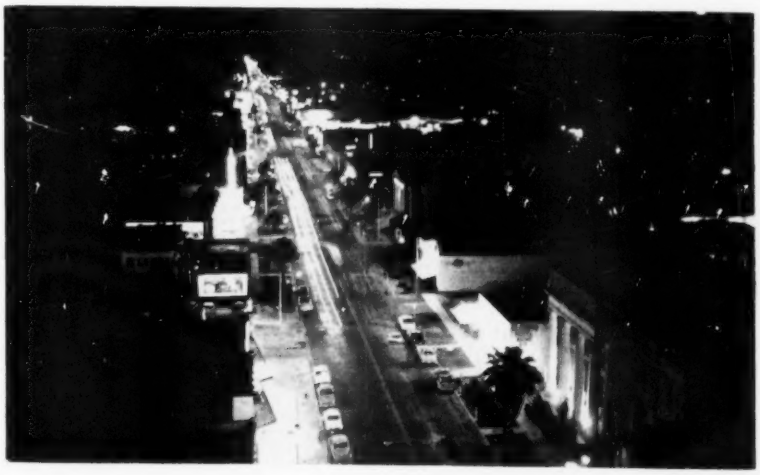
Modern Street Lighting Program Will Add 5500 Units

OFFICIALS of the City of Phoenix, Arizona were not satisfied with their street lighting and decided to do something about it. In August 1951 there were only 1900 street lighting units for the illumination of 347 miles of streets and 144 miles of alleys in the city.

At that time the city entered into a contract with the Arizona Public Service Company to install a modern street lighting system based on nationally recognized street lighting standards. Under the terms of the contract about 5,500 street lights are to be installed by 1955. As new areas are annexed to the city the number of lights will be increased from that figure keeping in mind that adequate lighting is to be furnished throughout all residential sections as well as business areas.

The Public Service Company is investing $1,300,000 in the lighting project. This amount will be repaid to the company over a twenty-year period, plus the cost of electric power and maintenance. Under the terms of the contract the city may purchase the street lighting system at some future time if it desires.

This information was abstracted from the recent, very excellent, readable and well illustrated report of the City of Phoenix, which was sent us by City Manager R. W. Wilson.



ly a right angle as possible and never less than 60 degrees. Property line radii at street intersections must be at least 20 ft. Tangents of at least 100 ft. must be introduced between reverse curves on arterial and collector streets.

Dead end streets cannot, except for strong reasons, be more than 400 ft. long, and they must have at the closed end a turn-around having an outside roadway diameter of at least 80 ft. Private streets are not permitted; every subdivided property must be served by a public dedicated street. Proposed streets which are obviously in alignment with others existing and named, shall bear the names of such streets. Other streets must be named without duplicating existing street names, irrespective of the use of such terms as street, place, court, etc. Alleys must be provided in the rear of all blocks used for business purposes, but will not be provided in residential blocks except for very cogent reasons.

In the final development, the street subgrade must be prepared and the streets surfaced with material of no lower classification than crushed rock, stone or gravel, laid by appropriate methods to a compacted depth of at least 6 ins. Pavement widths are as follows: Rural streets 22 ft.; minor residential and collector streets 36 ft. Arterial streets and highways must follow the master plan.

Except on rural streets, permanent 6-inch concrete curves with 24-inch integral concrete gutters or standard rolled curbs and gutters must be provided. Sidewalks must normally be provided on both sides of the streets, but exceptions may be made. Walks are located not less than a foot from the property line and will be 4 ft. wide and 4 ins. thick in single-family areas; in multi-family or group housing developments, walks will be 5 ft. wide; and in commercial areas 10 ft.

Blocks and Lots—Blocks should be not less than 400 or more than 1200 ft. long, and wide enough to allow two tiers of lots of minimum depth. Public cross walks may be required in blocks more than 800 ft. long; and occasionally approval may be given to a block having a single tier of lots.

Residential lots served by a public sewerage system must have a width of 60 ft. at the building setback line and an area not less than 6000 sq. ft. Such lots, when private sewage disposal is used, must have a corresponding width of 75 ft. and an area of 15,000 sq. ft.; and greater area may be required if the health department deems it necessary for proper operation of septic tanks. Similarly, if private water supply systems are to be used, the minimum size of lots will be determined by the health department after consideration of soil conditions, the proposed sewage disposal method and depth to ground water.

Setback lines for buildings must be not less than 30 ft., and in the case of corner lots 15 ft. from the side street. In general, corner lots must be sufficiently wider and larger to permit proper setbacks.

Public Use and Service Areas—Due consideration must be given to the allocation of areas for playgrounds and parks, and dedication or reservation of open space in the area up to 10 percent may, under certain cases, be required. Easements, not exceeding 12 ft. wide, may be provided for poles and wires, conduits, storm and sanitary sewers, gas and water mains and other utilities. Community assets, as trees and water courses, should be preserved.

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drainage system must be provided, including pipes, open ditches, culverts, inlets, bridges, etc., to care for surface water. Cross drains are necessary to accommodate all natural water flow across the full width of the roadway. Talbot's formula is used, with minimum pipe size of 12 ins. Tight joints, smooth flow lines and good construction practice are required. The top of the pipe must be at least 12 ins. below the road-bed.

Suitability of Land—Land that is subject to flooding or is deemed to be topographically unsuitable for residential use should never be approved for platting and development purposes; nor for any other use that may create danger to health, life or property or aggravate erosion or flood hazard.

Utilities—The sizes of water mains, the location and types of valves and hydrants, the amount of soil cover over the pipe and other details must conform to accepted standards of good practice for municipal water systems. The water system must serve adequately all lots shown on the plat for both domestic use and fire protection. Sewers must be so installed as to serve all lots. Where this is impossible economically, adequate areas must be provided for private disposal as approved by the health department.

Other Improvements—Street trees are desirable. It is recommended that street trees be planted inside the property lines to lessen the chance of damage to them. If planted in the right-of-way, locations and species are subject to planning commission approval. Street name signs should be placed at all intersections.

Where You Can Get the Complete Text—Write to the Tennessee State Planning Commission, 517 Commerce St., Nashville 3, Tenn., enclosing $1. Ask for publication No. 248.

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Sludge Lagooning at Winnipeg

THE Greater Winnipeg Sanitary District treats the sewage from Winnipeg and five smaller municipalities, totaling some 315,240 inhabitants. This is brought to the plant through an intercepting sewer 39,461 ft. long and 7'6" to 3'6" in diameter, built of alkali-resisting cement concrete. This intercepter receives the flow from 26 trunk sewers, which deliver the dry-weather flow to 16 comminutor stations where it is cut up and screened to ¼-in. size before discharge into the intercepter. Two Dorr "Si-feed" clarifiers remove the suspended solids, which are pumped to 4 digesters. Part of the gas collected from the digesters is used to heat the buildings and the digesters, the balance being burned as waste. In 1952, 65,100,500 cu. ft. of gas were produced; 25,874,900 cu. ft. used for heating; and 39,225,600 cu. ft. wasted. During the year they purchased 3,723,206 kwh of current for operating pumps and comminutors at the pumping stations and the main plant, at a cost of $32,429.35.

The method of disposing of the sludge has been given considerable study: In January 1951 a test was begun of the use of sand beds and of lagoons for this purpose. Studies were continued through 1952 and into 1953, when it is expected that a decision will be reached. There are 6 lagoons, each 100 x 150 ft., 3 of them provided with underdrains; and two sand beds, each 50 x 150 ft. Underdraining of sludge beds is unusual, but the experiment of underdrains was tried because of the impermeability of the gumbo in which

these are located. The year 1952 was the third warmest and second driest on record—with total precipitation 70% of normal. The lagoons with underdrains removed water more quickly than those without, but removal of the surface water was found to be the most important factor. Since natural evaporation was too slow, even in a year especially favorable for it, it was decided to decant the water from the lagoons. Calculation and discussions with other operators using lagoons led to the belief that consideration of underdrains is not necessary and the successful operation of lagoons will depend on the ability to decant or otherwise remove all excess liquids from the lagoons. Wooden drain boxes on the bank of the lagoon, with small weir stop planks on the side facing the lagoon, proved very successful for draining off the surface water.

Because of frost, no drying takes place from November to April. In the underdrained lagoon, the sludge was dry enough to be removed after 18 months, but it was thought it would have to remain for at least 24 months in the others. To date there has been no obnoxious odor from the lagoons.

The sand beds will give four loadings per year and can be used only during the summer season. The high construction costs and the very large area that would be required prohibit their use in Winnipeg.

• • •

Preventive Maintenance of Power Shovels Pays

On most grading jobs the power shovel is the bottle neck. When the shovel is not operating, neither are the trucks that service it, the bulldozer on the fill, nor most of the men on the job. Yet, on an average, 1.2 hr. out of every 10-hr. work day on such jobs are lost by shovel delays of 15 min. or more. This average is based on observations by a committee of the Highway Research Board of 41 shovels in use on 31 projects during three weeks of an active construction season.

Of the time so lost in maintenance and repairing of the shovel, 17% was due to waiting for repair parts, 6% for car body and crawler assembly, 5% motor, 4% cable, 26% for boom and dipper assembly except cable, and 40% for the power transmission system—clutches, brakes, gears, drums, controls, etc., except cables. Some of the shovels having the least delays were working in well blasted rock.

Trickling Filters

(*Continued from page 83*)

and supervises and approves connections to it.

Five-day BOD tests were run on this plant for both 1952 and 1953 with the results shown in Table 3.

The volume of sewage on Aug. 28, 1952 was 250,000 gpd and on July 13, 1953 was 350,000 gpd as against design basis of 500,000 gpd. The effluent was clear and odorless and was hardly noticeable where it entered a small brook having a summer flow smaller than the effluent from the plant.

Resume of Plant Conditions

These three plants all use a variation of the Bio-Filter system and show good results. Woodridge had a standard-rate trickling filter with a good underdrain system and good filter media. With the addition of recirculation and a new high-rate distributor a noticeable improvement in effluent quality was obtained.

Kauneonga Lake has well constructed high-rate filters equipped with good rotary distributors. Despite the poor grade of gravel filter media this plant produces a good effluent. Some of the sand and dirt from the original gravel is still being washed off into the pump sumps after nearly two seasons of operation. With continued good operating care an even better effluent should be obtained in the future.

The Sackett Lake plant has well designed and well constructed filters and the same fine effluent can be expected up to the design capacity of the plant.

From the results obtained at the Woodridge plant, it is shown to be practical to convert a well constructed standard-rate filter into a high-rate filter. The reduction in BOD to be expected can be calculated within a reasonable amount.

Table 3—Operating Results at Sackett Lake, N. Y.

	Aug. 28, 1952		*July 13, 1953*	
	BOD	**SS**	**BOD**	**SS**
Raw Sewage	230	128	210	164
Primary Infl.	80	—	85	—
Primary Effl.	50	—	76	—
Pri. Filter Effl.	30	—	80	—
Sec. Filt. Infl.	27½	—	37	—
Sec. Filt. Effl.	26	—	Sample spoiled	
Final Effluent	14	26	12	11

In the case of the Kauneonga Lake plant, the results indicate that old ungraded gravel filter media is a poor investment, although lack of money sometimes may make its use mandatory. It is hard to predict the results that we may get from this plant if it is overloaded.

The Sackett Lake plant, using a liberal design for a bio-filtration system, produced excellent results.

The treatment of sewage using standard primary and secondary clarifiers and either bio-filters or standard-rate filters has now reached the stage where an engineer can provide a well designed plant and can predict within a very small range, the actual BOD of the final effluent from the plant.

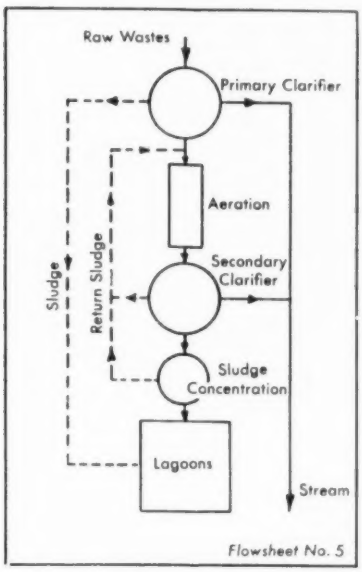
Activated Sludge for Industrial Wastes

(*Continued from page 73*)

Phenol Wastes. — These wastes are troublesome, especially where the effluent is discharged into potable water sources, as they impart a disagreeable taste to the water. The outstanding example of treatment of these wastes in large volume is at the plant of Dow Chemical Company at Midland, Michigan. The volume of wastes is approximately 25.0 mgd. This plant was designed to remove 5000 pounds of phenol per day, or 15,000 pounds of BOD. That this is done is proven by the records which show maximum daily removals of phenol of 5,642 pounds and 6,520 pounds in February, 1952, and April, 1953, respectively, and maximum removals of 22,100 and 14,900 pounds of BOD per day, respectively, for the same two periods. This is the largest plant in which Jet-Aerators are used, as they were developed for this plant by the Dow Chemical Company engineers. There are 350 jets dispersing 2700 cubic feet per minute of air and using 4000 gpm of water at 25 psi. The horsepower required is 225 for this operation.

In England it is reported that 100 percent of phenol was removed with an aeration period of only 8 hours.

Pulp and Paper Mill and Paper Wastes. — These include the white water wastes, the wastes from sulphite mills and the wastes from the



Flowsheet No. 5

● **TREATING de-inking wastes by aeration for re-use of paper fiber.**

de-inking plants for the reuse of paper fiber.

Rudolfs[7] states regarding the treatment of white water by activated sludge "white water concentrate up to BOD of 4300 ppm is amenable to treatment by activated sludge". It is stated that about 96% of the applied BOD can be reduced in an aeration period of 22 hours, with a loading of approximately 300 pounds of BOD per 1000 cubic feet of aeration tank volume.

On sulphite wastes Gehm[6] has said that tests with the activated sludge process conducted at the University of Wisconsin and by a large sulphite pulp manufacturer indicated that the process is entirely unworkable except for the treatment of a very small amount of the waste liquor diluted in a large volume of sewage.

Other reported results show that with a 25% concentration of sulphite wastes in municipal sewage and with 22 hours aeration period, a reduction of 95.5% was obtained.

Wastes from the de-inking of paper for reuse of the paper pulp can be treated effectively by activated sludge. At the plant of the Michigan Paper Company, Plainwell, Michigan[7] the layout is as per Flowsheet No. 5. On a flow of 0.50 mgd. to the primary clarifier with a detention of 8 hours in the aeration phase, satisfactory removals of BOD were obtained.

Powder Plant Wastes. — It is believed that activated sludge offers an opportunity for good efficiency on this type of waste as it combines aeration and biological oxidation. It would be difficult to operate at high efficiency due to variations in the character of the influent.

Wool Scouring Wastes. — It is reported that activated sludge treatment of sewage containing large amounts of wool scouring effluent caused a precipitation of the bulk of the grease added in the waste, but that the time required for aeration was out of proportion to the results achieved. With the grease removed and with neutralization of the wool scouring waste, good results could be obtained by the activated sludge treatment when combined with municipal sewage.

Starch Plant Wastes. —*Corn starch* —At Decatur, Illinois,[8] the municipal sewage treatment plant handles the city sewage and the wastes from the corn products plants. The com-

bination plant is designed for 150,000 population equivalent with equal volumes of waste and sewage. The city population amounts to 65,000. The loading of the aeration tanks is about 25 pounds per 1000 cubic feet of tank capacity. Only one-third of the settled sewage is treated by the activated sludge units.

Potato starch—Experiments by the U. S. Department of Agriculture[9] showed that the chemical oxygen demand (COD) of waste filtrates could be reduced from 4000 to 600 by batch or continuous fermentation and that, with an inoculum of activated sludge under aerobic conditions, the method could produce a reduction to 200, or over 95% reduction of COD.

Laundry Wastes. — Treatment of these wastes by activated sludge is believed feasible but is not considered economic due to the very long periods of aeration that would be required.

Ammonia Still Wastes. — At Gary, Indiana, the ammonia still wastes from the steel mills were combined with the sewage at the city sewage treatment plant to deterimne how effectively such wastes could be treated by the activated sludge process. The total flow of combined sewage and wastes averaged 21.67 mgd, with the waste volume averaging 210,175 gallons per day or approximately 1% of the total volume. The average total monthly amount of phenol contributed by the raw ammonia wastes was 20,719 pounds and the amount of phenol in the final plant effluent averaged 11.8 pounds per month. The average air volume used in treating the combined sewage and wastes was 0.523 cu.ft./gal., and the average detention period in the aeration step was 5.0 hours.[10]

Petroleum Refinery Wastes. — There are very little recorded data on the use of the activated sludge process with these wastes. In one test operation it is stated that over a period of 24 days, with aeration of 12 hours, a reduction of 92% of the BOD was obtained.

On another test on wastes with high salt content, it was shown[11] that with a waste with 1250 ppm BOD, with 12 hours aeration, phenol removal was 93%. The sludge concentration was 4000-5000 ppm, and the aeration tank loading 140 pounds of BOD per 1000 cu. ft. of tank volume. Air was stated to have been 0.9 cu. ft. per min. per sq. ft. of aeration surface.

Rag, Rope and Paper Factory Wastes.—The wastes from specialty paper mills probably represent a very small proportion of the total of paper mill wastes. It is stated[12] that plant scale demonstrations with activated sludge on these wastes showed a BOD reduction of 70% with 24 hours aeration with air supplied at 2.75 cu. ft. per gallon of waste.

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Baled Hay Helps Pay Airport Expenses

Industry and municipality got together with profit to both at Lancaster, Pa. At the municipal Airport there are 169 acres of grasslands, and this area is used by New Holland Machine Co., manufacturers of farm machinery, as an experimental area. Last year, the hay baled and sold to farmers netted $1200. Reports are that the 1953 crop may be even larger.

PUBLIC WORKS DIGESTS

THE SEWERAGE AND REFUSE DIGEST

Refuse Composting In Scotland

A composting plant has recently been put into service at Kirkconnel, Scotland, which is considered a model for disposing of the refuse and sludge of a population of about 8,000. The sewage is treated by sedimentation, biological filtration and a humus tank, and the sludge, about 1800 gpd, is delivered to the composting building and mixed with from 4 to 8 tons per week of refuse. The refuse is screened to remove particles under 7/16 in., and ferrous metals removed magnetically and other metals, paper, rags, bones and glass picked by hand from a belt; and the rest, mostly vegetable matter, is pulverized. The dust averages 6000 lbs. a day, the pulverized matter 900 lb. These are mixed in the proportion of 1800 lb. of dust (the remainder is disposed of otherwise), 900 lb. of waste vegetable matter, and 1,000 gal. of wet sludge. The two former are deposited in four mixing chambers which have floors sloping to a central drainage channel. Above the sloping floors is a false floor of 2-in. planks spaced 1 in. apart. On this floor is spread a 9-in. layer of the dust and pulverized matter, and 600 gal. of sludge is dispersed over this. Much of the moisture drains off through the floor and is returned to the sedimentation tanks. The film of sludge remaining in the tank is mixed with the waste with a muck fork and 20 lb. of ground limestone sprinkled over the surface. Other similar 9-in. layers are laid in succession until the mixing chamber, 5 ft. 6 in. deep, is filled. Then vertical holes are punched through at 3 ft. intervals to admit air. The mixture remains in these chambers for about a week, when the moisture content is reduced to about 60% and intense biological activity has started. It is then transferred to composting cells, which have ventilators in each wall to facilitate circulation of air, and laid down in 9-in. layers mixed with 1100 lb. of dry refuse dust, reducing the moisture to about 45%. Here the temperature rises to around 180° within 3 or 4 days, then falls to 110° at the end of 5 weeks, when it is transferred to maturing bays, during which transfer air is absorbed, causing a rapid rise to 150°, after which it falls slowly for 5 weeks to atmospheric temperature and is in a condition approaching that of humus. It is then passed through an agricultural chopper, bagged and sold at 7 *s* 6 *d* per hundred pounds in small lots, to 80 *s* per ton for 10 tons or more.

"Kirkconnel Composting Plant." *Municipal Engineering* (England), July 17.

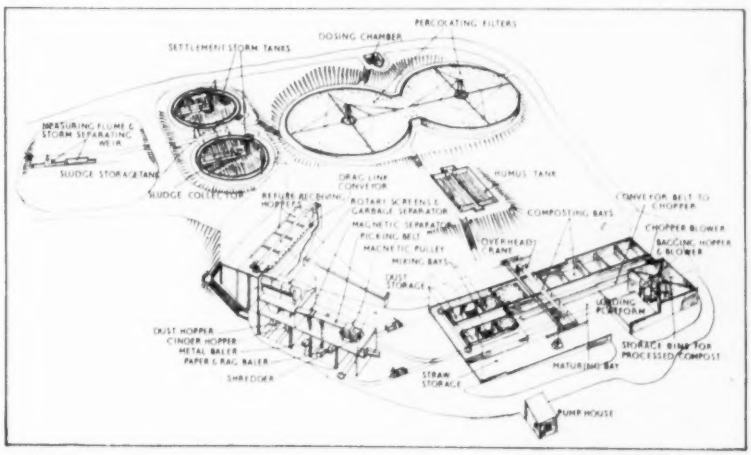
Microstraining Sewage Effluents

Further clarification of effluents from treatment plants is often desirable, especially if they are to be chlorinated, and sand filtration is commonly used for this purpose. Microstraining is suggested instead. By it, significant reductions in suspended solids and BOD can be achieved. By an English installation, suspended solids are reduced from 30 to 10 ppm and BOD from 25 to 10 or 15 ppm.

"Application of the Microstrainer in Great Britain;" Discussion by A. A. Kalinske, Director of Development, Infilco. *Journal, Am. Water Works Ass'n.* July.

Wastes Treatment In South Dakota

Although South Dakota has only 650,000 population, primarily agricultural and with relatively small cities, there are 125 municipal sewerage systems. The treatment plants handle wastes from milk processing plants, creameries, packing houses and sugar beet plants. The author describes five plants installed by five types of industries during the past three years. A lithium mineral concentrating plant uses lagooning; a hog killing plant uses sedimentation in a Colloidair separator and a trickling filter; a sugar beet plant, with an operating season of two months or less, depends chiefly upon lagoons; a cheese factory, the



Courtesy Municipal Engineering

● **COMPOSTING plant, Kirkconnel, Scotland, for disposal of refuse and sludge.**

whey from which had caused septicity in the municipal plant, installed a roller drier in which all of the whey is dried and the material is processed into feed; a creamery company's wastes are treated in a municipal plant consisting of an Imhoff tank (detention period of 2 hr. maintained by recirculation), trickling filter and final settling tank. The trickling filters, because of the severe winter weather experienced in that state, are surrounded by wind-breaker walls 7 ft. high to reduce the danger of freezing.

"Solving Industrial Waste Disposal Problems in South Dakota;" by R. J. Stapf and C. E. Carl, S. D. Dept. of Health. *PUBLIC WORKS*, August.

Hempstead's 700-Ton Incinerator

Hempstead, Long Island, N. Y., a township with a population of about 450,000, has constructed an incinerator with a capacity of 700 tons in 24 hours. It is located in an area of 167 acres close to tide water and capable of receiving the incinerator residue for many years. It consists of four Morse-Boulger furnaces provided with rotating stoking mechanisms, Beaumont - Birch charging gates and drained roller ash gates. Conveyors discharge the ash into a bin through a screen that removes tin cans and other large unburned matters. Two combustion chambers heat two boilers, each with a capacity of 60,000 lb. of steam per hour, part of which is used to operate two turbo-generators, each with a capacity of 1,000 kw—more than enough for winter-time demands of power, light and heat. Each boiler is served by a fly-ash arrestor of the cyclone type to intercept 90% of the fly-ash sizes exceeding 15 microns. The fly-ash is discharged into tanks of water and drained to a lagoon. Induced draft fans take the place of a high chimney.

The trucks that collect the refuse will discharge it into large trailers located at strategic spots, which will, in the evening, be hauled to the incinerator and dumped into one of two pits; from which the refuse will be raised in 3-yd. buckets by cranes to the furnace charging gates.

"In Hempstead the Incinerator Has to Be Big and Tidy;" *American City*, July.

Suggestions For Economy

An engineer who has been both city engineer and engineer for a contracting firm believes that many cities have paid too much for their sewerage systems and treatment plants and offers suggestions for reducing the costs, beginning with simplifying the plans, on through to securing better bids. The latter are especially interesting because of reflecting the ideas of contractors. He says: "The less risk incorporated in the plans and specifications, the more competitive will be the bidding and the more likely it will be that a reputable contractor will be the low bidder." "No amount of policing can get a good job out of a contractor who is losing his shirt, who doesn't know how, or who just doesn't intend to give a good job." "Use unit prices as much as possible. . . Bids on unit price contracts practically always are closer together than lump sum bids." "Furnish local subcontractors with data so that they will be prepared to quote. Painters, roofers, sheetmetal contractors, millwork suppliers, electrical and mechanical contractors, masons, and similar specialists in the immediate vicinity of

a project can generally quote better prices than subcontractors from farther away." Contractors need considerable money to start and carry on a contract, which is usually borrowed, and "Anything that can be done to lessen this financial burden will enable more contractors to bid, and will permit them to bid a little lower."

To designers he suggests that a device that will reduce the operating force by one man justifies the expenditure of $40,000 for installing such a device. Insulation of digestion tanks and increased use of sludge thickening devices (thus reducing the amount of water to be heated) may be justified by reduction in heating costs.

"Are Sewage Works Costs Justified?"; by L. L. Sphar, Pub. Wks. Engr., Olympia, Wash. *Sewage and Industrial Wastes*, July.

Relation Between Chlorine Residual and Coliform MPN.

The authors, engineers and chemists of Interstate Sanitation Com'n., make statistical analyses of nearly 5,000 coliform tests at about 100 treatment plants to learn if any pattern of chlorination results could be established for the totality of plants —a relationship between residual chlorine and MPN of coliform organisms. At any given plant this relationship can be expressed by a curve of the type $\frac{1}{\log \text{MPN}} = a + bR$, in which R is the total chlorine residual, and a and b are constants. Individual curves can be used to estimate the chlorine residual required to maintain any given MPN within the required degree of accuracy. A relationship is demonstrated between values of a, equal to 1/log. MPN at zero residual, and b, which is directly proportional to the killing rate.

"Bactericidal Effects of Sewage Chlorination;" by Seth G. Hess, Alex N. Diachishin and Paul De Falco, Jr., Chief and Prin. Engrs. and Chemist, Interstate San. Com'n. *Sewage and Industrial Wastes*, July.

Moving Baffles In Sedimentation Tanks

Short-circuiting and eddy currents in a sedimentation tank can not be eliminated by fixed baffles, but the author believes that they can be by use of baffles extending 6 in. below the surface and moving at a rate not greater than that which will carry a baffle from entrance to outlet end in 30 minutes. Then a stratum of sewage 6 in. deep will move uniformly through the tank, and the 30-minutes wll suffice for all settleable matter to settle out of the stratum, remaining in the tank, which can be very shallow. The rate of movement of the baffles must be so regulated as to conform to the rate of flow of the water. So operated, a tank 10 ft. wide by 20 ft. long will clarify 36,000 gpd of sewage.

"Moving Baffles in Sedimentation Tanks;" by F. E. Daniels, Consulting Chf. Chemist, Penn. Dept. of Health. *PUBLIC WORKS*, August.

Vitamin B-12 From Milwaukee Sludge

The Milwaukee Sewerage Com'n. has made a contract with the Vern E. Olden Co. whereby the latter will produce Vitamin B-12 concentrate from "Milorganite," the dried sludge from the Milwaukee sewage treatment plant. This vitamin is effective against pernicious anemia and has important influence on growth. It will at first be marketed as a supplement

to animal and poultry feeds, for which purpose it has been approved by the Federal Food and Drug Administration. A pilot plant will be operated for a year and then, if it seems to be practicable, a $1,000,000 plant will be built. The Sewerage Com'n will get 35% of the net profits. The extraction will not decrease the value of the Milorganite as a fertilizer, from which the city now receives a gross revenue of $2,400,000 a year.

"Vitamin B-12 to Be Produced From Milwaukee Sewage Sludge." *Wastes Engineering*, August.

Siphoning Sewers Under Chicago Expressway

Chicago's Congress Street Expressway, now under construction, extends for eight miles across the city in a 14-ft. depression 326 to 465 ft. wide. It crosses a number of combined sewers, which have to be carried under it in inverted siphons and kept in service during construction. Most of them are 60 in. or more in diameter. Dry-weather flow is about 8 to 12 in. deep. A typical siphon is described. Three siphon pipes are provided—a 16 in. c. i. pipe for dry-weather flow; a 30-in. concrete pipe with c. i. fittings for storm water; and a 48-in. concrete for peak flows, also with c. i. fittings. All have entrance flow lines at the same elevation as the original sewer, but baffle plates or weirs prevent each of the larger sewers from coming into operation until the smaller one is running full. The bottom horizontal stretch of each siphon pipe is connected to the old sewer by an inclined stretch of pipe with a 45° Y and elbow at its ends, and is continued horizontally at each end to a vault, where it is provided with a flange which can be removed for rodding the sewer. The pipe sizes are designed for velocities of 3 fps or better.

"Siphons Carry Sewage Under Expressway;" by D. W. Johnson. *PUBLIC WORKS*, August.

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Motion Pictures

(Continued from page 96)

assistance and animated charts will probably be beyond the skill of the local club unless they have some exceptionally capable members.

Sound will add to the value of the picture and the narrative should be carefully prepared. The tendency is to use too much narrative and not

leave time for the picture to tell its story. A local man can generally be found to do the narration. Tests on a sound recording machine will soon tell who has the most effective voice and delivery.

Music will make the film more interesting. Here professional advice should be sought. Only music in the public domain can be used without paying a royalty to ASCAP. Don't think because music is old that you are free to use it. That may, or may not, be true. Recording the sound on the master film should be done by a professional organization.

Additional copies of the film can be made at a reasonable cost. The original film should not be projected but kept to serve as a negative for the production of additional copies.

Now the job is to show the picture during the six or eight weeks before the election date. Fortunately 16 mm sound projectors are well distributed now and most organizations have access to one.

The job of promoting the showings before various local organizations and keeping track of the films should be assigned to one person who should keep records of where the film was shown and how many saw it. Another new outlet is television stations. Local stations can usually be persuaded to use all or a part of the film as a public service.

This is one way that public officials can present information about needed construction projects to the citizens at no great cost. It goes without saying, of course, that the better the film, the more effective its message will be.

If you have done a job of this kind, tell the editors of *Public Works* about it.

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Velocity in Pipes Inhibits Tubercle Formation

Observation of the interior of a Venturi meter and adjoining pipe, all cast iron, after 7 yr. in service in the Chicago, Ill., water system, seems to indicate that a water velocity close to 12 ft. per second will prevent tubercle formation; consequently that loss in carrying capacity may be lessened considerably in feeder mains in which a relatively high velocity is maintained.

The Venturi in question decreased in diameter from 60 in. to 45 in. It was of cast iron, milled inside and coated with coal tar, with two narrow hollow brass rings in the circumference feeding the piezometer tubes. Water containing chlorine, often in excess of 1 ppm has been passing through the meter at velocities averaging 8.7 fps at the entrance and 15.5 fps at the throat. At the entrance to the meter were found cone-shaped tubercles, many of them 2 in. long. Many of those adjacent to the brass ring project over it fully an inch. In the converging section, the tubercles are more slender and more widely separated as the diameter decreases, and there are very few in the throat; also very little coal tar is left there, and there is a little rust. Photographs show most of the tubercles to be long and slender, and pointing in the direction of flow.

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Sterilizing New Mains

In laying water mains, Springfield, Ill. Water Department tries to minimize the procedures of final sterilizing by preliminary precautions. The contractor is required to mop the inside of each pipe with a thick lime slurry a few hours before it is placed in the trench, removing all dirt, and leaving a surface from which any dirt entering later

will flush out easily. Only sterile gaskets or mechanical joints are used. No trench water is permitted to enter the main, temporary watertight plugs being used whenever necessary. As a result of these precautions, only a good flushing of a completed main is required to produce negative bacterial samples, in most cases. Where it does not, not more than one shot of chloride is necessary.

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Reducing Pollution by Cotton Finishing Wastes

A SURVEY of stream-pollution wastes from New England industries shows that the textile industry provides 47% of the total industrial pollution load. For every 1,000 lbs. of cloth finished, 650 to 750 lbs. of processing chemicals and natural cotton impurities are discharged into the receiving stream. This industry therefore has received special attention by the New England Interstate Water Pollution Control Commission. Studies have been conducted for the Commission during the past two years by Wesleyan University and the University of Rhode Island, and a report has been published which is remarkably valuable for its clear, logical presentation of the facts determined by a thorough technical and practical study; and for practical recommendations of changes in processing whereby it believes that the BOD of the wastes discharged can be reduced 50 to 70% without spending money for treatment plants or chemicals.

The surveys showed that cotton mill effluent normally will be a dilute solution of starch and its degradation products; natural cotton compounds removed in kiering; sodium acetate; soaps; and detergents mixed with sodium hydroxide, sodium carbonate, sodium sulfate, sodium silicate and sodium chloride. It will have a pH of 8.0 to 11.0, a gray colloidal turbidity, and be slightly tinged with dye color. It will probably contain 1,000 to 1,600 ppm total solids, 200 to 600 ppm BOD., 300 to 900 ppm total alkalinity; 1 to 3 ppm chromium and 1.3 ppm sodium hydrosulfite. Suspended solids contents will be under 30 to 50 ppm. The use of detergents is expected to lower the BOD but increase the dispersion of some settleable solids.

Starch and its degradation products account for 30 to 60% of the total BOD. A surprising revelation was the high BOD contribution found for acetic acid, which has a 52% of the BOD; a greater amount where printing is done. If sulfuric acid, which has zero BOD, were substituted all of this could be eliminated.

It is shown that "substitution of proper processing chemicals can lead to pollution elimination without treatment, and it is believed that thorough investigation can lead to elimination of at least 50% and probably 70% of the total BOD. The savings in treatment facilities and costs so effected would be tremendous." Low BOD substitutes for starch may be used. If carboxymethylcellulose (3% BOD) were used as a sizing agent and as an adhesive filler, 35% to 55% of the total BOD discharged by textile plants could be eliminated. Substitution of detergents for soap could reduce the BOD by 20%; and a 17% reduction could be obtained by substituting sulfuric acid in place of acetic acid, or by using inorganic acidic buffers of 0% BOD.

Assuming that all the suggested substitutions could be made successfully, a total reduction of 60 to 70% could be effected without spending money for treatment plants or chemicals.

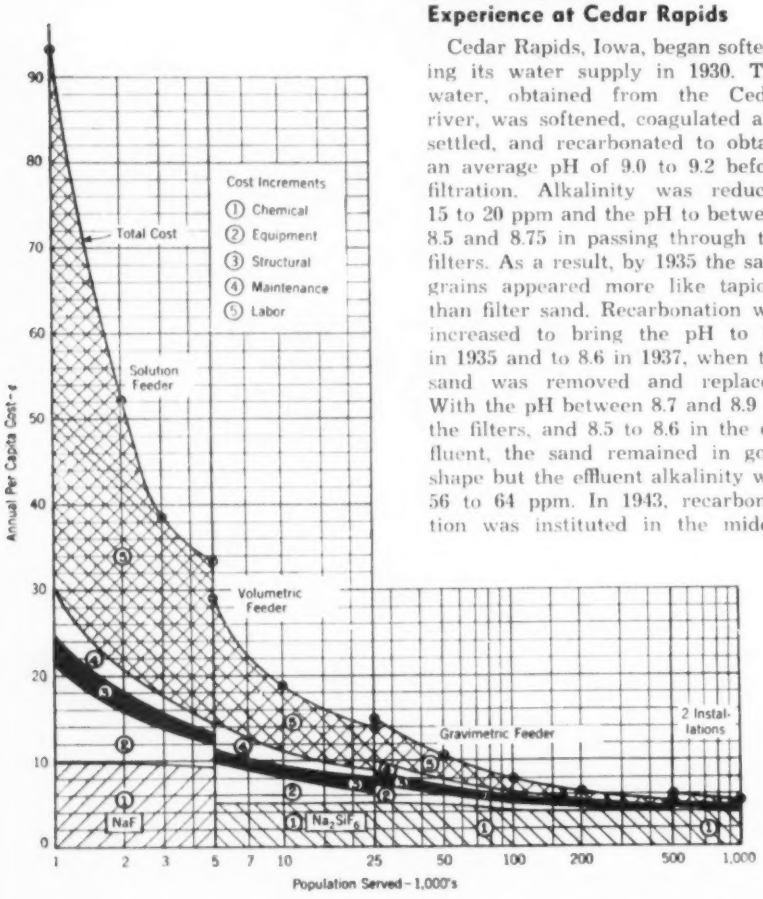
PUBLIC WORKS DIGESTS

THE WATER WORKS DIGEST

Costs of Fluoridation Treatment

These may be divided under the heads of equipment, chemicals, plant structure, maintenance, and labor. The equipment, in addition to feeders may include a meter, ejector or corrosion-resistant pump, dust collectors and safety devices for operators, conveyors, hoppers, equipment for automatically stopping the plant if the feeder overfeeds, or underfeeds, if the water supply fails, or the screw conveyor fails to operate properly. Plants already operating treatment plants may need little or no new structures. In the accompanying graph, the consumption is assumed at 100 gpd, and the dosage at 1 ppm.

"Fluoridation Costs and Problems;" by H. Christopher Medbery, Engr. of Water Purif., San Francisco. *Journal, Am. W. W. Ass'n*, July.



Courtesy Journal AWWA.

● **VARIATIONS in annual per capita costs of fluoridation vs population served.**

Hexametaphosphate Experience at Cedar Rapids

Cedar Rapids, Iowa, began softening its water supply in 1930. The water, obtained from the Cedar river, was softened, coagulated and settled, and recarbonated to obtain an average pH of 9.0 to 9.2 before filtration. Alkalinity was reduced 15 to 20 ppm and the pH to between 8.5 and 8.75 in passing through the filters. As a result, by 1935 the sand grains appeared more like tapioca than filter sand. Recarbonation was increased to bring the pH to 8.8 in 1935 and to 8.6 in 1937, when the sand was removed and replaced. With the pH between 8.7 and 8.9 on the filters, and 8.5 to 8.6 in the effluent, the sand remained in good shape but the effluent alkalinity was 56 to 64 ppm. In 1943, recarbonation was instituted in the middle of the process, bringing the pH to about 10, and the water settled for several hours. This reduced the alkalinity to 38-45 ppm. The pH of the plant effluent then averaged 9.1, but fell to below 8.0 at some ends of the system. Experiments were conducted with sodium silicate, but silica scale caused trouble for the local power company and this was discontinued.

In one district, supplied by an 8 mg storage reservoir and where the piping is old and dead ends numerous, rusty water was a serious problem; in spite of hydrant flushing once a week, the iron content was never less than 0.4 ppm. Sodium silicate applied at the booster station gave only partial relief. Beginning in 1949, 2.0 ppm sodium hexametaphosphate has been added and has given such completely satisfactory results, that since 1950 sodium hexametaphosphate has been applied at the main plant at rates of about 0.5 to 0.75 ppm. With this practice, alkalinity and pH have been maintained at the far ends of the system the same as at the plant effluent where the pH is about 9.6. There have been no filtration difficulties, the washwater averages 2% or less, and the sand has not grown appreciably in size.

"Corrosion Control Experience in Cedar Rapids, Iowa;" by Arnold K. Cherry, Chemist, city water works. *Water & Sewage Works*, July.

Flood Protection In the Kansas River Basin

A committee of engineers was appointed last year by the Kansas Industrial Development Commission to analyze plans for reduction of flood discharge in the Kansas River basin as promulgated by the U. S. Engineer Corps, the Bureau of Reclamation, and the Dept. of Agriculture. It did not recommend any of these. It would require 50 years to complete the overall program.

of reservoir construction recommended by the engineers. The greatest damage done by floods has been to cities, while the relatively smaller damage to rural areas was compensated by the improvement in productivity of the farmed land by deposits of soil by the flood waters; and the areas removed from cultivation by construction of the proposed reservoirs would be half as great as the areas protected. It is therefore proposed by the committee that protection of the urban areas only be attempted, which could be effected by enlargement of the channels opposite such areas and the construction of levees. It is estimated that the cost of this plan would be not more than 25% of that required for the combined reservoir and local protection programs as now envisioned.

"Flood Protection in the Kansas River Basin;" by N. T. Veatch, Louis R. Howson and Abel Wolman. *Journal, Am. W. W. Ass'n.*, July.

Ferrous Sulfate Treatment at Chicago

Since April, 1952, the Chicago Bureau of Water has treated part of the water to be filtered with ferrous sulfate as a coagulant, combined with lime, and the remainder with alum. The overall effect of the iron-lime treatment was to obtain better removal of plankton and turbidity by settling in the basins to which this treatment was applied; and the number of washes of the filters was decreased. During one 42-day period, when half of the treated water was treated each way, in the galleries supplied with iron-lime treated water, the number of filter washes averaged 47 per day and the wash water 2.72%; while in the galleries supplied with alum-treated water the washes averaged 67 and amount of wash water 3.90%. The iron-lime treatment removed 83.3% of the plankton and 78.1% of the turbidity; while the alum treatment removed 76.7% of the plankton and 62.5% of the turbidity. During another period when one-third of the water received iron-lime treatment and two-thirds alum, two galleries of filters received alum treated water and two others a mixture of the iron-lime and alum treated waters. During this period, the latter averaged 36 washes per day as compared with 49 for the other two. The basin receiving iron-lime treatment removed 91.9% of the plankton and the two receiving alum treatment, 85.4%.

"The Effect of Ferrous Sulfate-Lime Treatment Upon Plant Operation." *Pure Water*, May.

Water Service For Surburban Areas

A progress report of the Committee on Water Main Extension Policy occupying 24 pages of the Journal, treats exhaustively the problem of providing water service for suburban areas—methods, rates and policies. The service may be furnished either from that of the parent municipality or by a metropolitan or independent suburban utility. Under the former, the city may own the mains and facilities, or may sell the water to a suburban utility. The courts have generally held that a utility has a right to charge more for water furnished to outlying districts than for that furnished within the municipality. Under normal circumstances it will be legal to extend water service into suburban districts, and will be desirable if the suburban business is developed upon a sound financial basis, with safeguards to protect the city against uncontrollable fringe growth. Rates for suburban service may be sub-

ject to the juridiction of the public service commission. Collection for fire protection in suburban areas can be done through the creation of "fire districts" or by surcharges to bills for metered service. Suburban policies should be nondiscriminatory, based upon business principles, assure that the main extensions will be self supporting, and provide for customer participation in the financing of extensions if the anticipated revenue is insufficient to warrant the utility's financing the extension unassisted. The Committee recommends several rules to be adopted to guide the application of these policies.

"Water Services for Suburban Areas," *Journal, Am. W. W. Ass'n*, July.

Greater Efficiency In a Modernized Plant

Beloit, Kansas, constructed a water plant in 1917 and enlarged it in 1935, but by 1945 it was again outgrown. As there was no room for further expansion and the site was several feet below flood level in the adjacent river, a new location was chosen and a new plant built in 1950, with a softening and filtration plant and new centrifugal pumps, with a capacity of 1.5 mgd. Comparing the new plant with the old, the billable gallonage per kwh of power consumed has increased 19%, and the net operating profit 90%. Pumping costs per gallon dropped 16.3%. Better water is furnished with 6% lower chemical cost per gallon. Pumping costs dropped from 3.14 ct. per thousand gallons in 1949 to 2.58 ct. in 1951. All pumps are F.M. electric; chemicals are bought in bulk and brought 180 ft. from a rail spur by Dracco pneumatic conveyors and fed by Omega feeders.

"How New Pumps Cut Water Plant Power Costs;" by Ray G. Vollendorf. *PUBLIC WORKS*, August.

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College Courses in Contracting

Contracting, once largely relying on getting maximum pick-and shovel work out of common—very common—labor, has long since become big business requiring the investment of large sums in equipment, and is now enlisting men of high intelligence with special education and training. The 6,500 members of the Associated General Contractors of America are tangibly supporting a program designed to supply the industry with men equipped with a type of training hitherto not available. To supply these men it is turning to the engineering colleges, donating funds to finance expansion of civil engineering departments, encouraging student enrollments, sponsoring scholarships, and furnishing instructors from industry.

"Construction" or "contracting engineering" courses are offered as an option within the civil engineering department or as a special degree curriculum of its own. In 1948 the University of Michigan, recognizing that about half of its civil engineering graduates were being employed in the construction field, offered an option in construction engineering, including courses in estimating, construction methods and equipment, accounting, legal phases, business enterprise and labor relations. A fifth year, leading to a Master's degree, includes courses in economics, personnel administration, accounting etc., to prepare for exercising administrative as well as technical responsibility.

North Carolina State College offers a four-year construction curri-

culum sponsored by the Carolina Branch of A.G.C. Other local branches work with the colleges of their states, furnishing lecturers for civil engineering courses, offering scholarships, etc. These include the Universities of Arizona, Colorado, Iowa, Nebraska, Utah and Wyoming.

Graduates with such a foundation who later develop a talent for organization and accurate bidding, and a willingness to assume risks which has brought general contracting to its present high standing will undoubtedly raise it to still higher ones in the future.

Up Front For Adequate Roads

(Continued from page 16)

have seen and think might qualify for prizes: Going-to-the-Sun Highway in Glacier National Park in Montana; Trail Ridge Road in Rocky Mountain National Park, Colorado; the old Storm King Highway along the Hudson in New York; the old (haven't seen the new) Columbia River Highway in Washington; and the Skyline Drive in Shenandoah National Park, Virginia. Then, too, how about the Wawona Road and Tunnel, in Yosemite, with its "explosion" view of Yosemite Falls, the Overseas Highway to Key West, Florida, or U. S. 90 in the bayou country of Louisiana or between Pass Christian, Mississippi and Mobile, Alabama? Then, too, we keep thinking about that gorgeous drive from Honolulu past Waikiki and Diamond Head to Pali Point on Oahu. These are just a few. What's your nomination for the most beautiful road in the country? Just tear off the top of an old Cadillac and send it in with your entry.

On the Ball — California has adopted a legislative program which will produce about $70 million of additional revenue for highways each year and will completely meet the needs of the state highway system over a 15-year period. California, Washington and Oregon combined will this year spend over $350 million on their state highway systems, covering a total of about 27,000 miles of highways. The other eight western states will spend less than half this amount, although their combined total mileage of state highways is considerably more. Maryland can take pride in its $568-million 12-year road program, about which Roy E. Jorgensen, engineering counsel of the National Highway Users' Conference, has said "To my knowledge, there is no other state, at this time, which has a program of highway improvement and a financial plan geared to it which gives such promise of adequate roads within a reasonable period of time." The most populous county in the nation, Cook County, Illinois (4.5 million people) is going ahead with the development of its 230-mile expressway system which is scheduled for completion in 1961.

Waste — A new booklet, attractively illustrated, has been issued by the Automobile Manufacturers' Association, Detroit, under the provocative title "Waste—$3 Billion Yearly". The 3 billion dollars is AMA's estimate of economic losses which occur every year because of increased gasoline and other operating costs, traffic accidents and commercial vehicle time losses on our existing highway system.

From Here and There — We hear that Cornell's annual school for town highway superintendents of New York state was a big success, as usual. The Connecticut State

Highway Department has built test sections to evaluate both natural and synthetic rubber as an additive for hot asphaltic concrete. General Eugene Reybold, Executive Vice President of the American Road Builders' Association, has recommended a thorough study of highway problems by a joint congressional committee. Contracts for the last few miles of the 427-mile main portion of the New York State Thruway will be let soon: target date for completion of the primary section is next fall. South Dakota has finally joined the Union and will require drivers to be licensed beginning next January 1; guess they finally decided that the automobile was here to stay. L. S. Tuttle, formerly Assistant to the Commissioner of Public Roads and one of our favorite people, has joined the staff of the Automotive Safety Foundation. New York and Maine have recently enacted legislation which makes it a traffic offense to drive at an unreasonably slow rate of speed.

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"Doc" Symons

(Continued from page 14)

Did You Know — That there are only an even dozen (12, that is) cities in the world whose names start with the letter "M" and which have a population of over 500,000? Can you name them?

★ ★ ★

The Russians were first—again! Recently I had occasion to review the report by the Ohio River Valley Water Sanitation Commission on "Phenol Waste Treatment" published in 1951; it detailed experiments on treatment with chlorine, chlorine dioxide and ozone. I also had occasion to review an unpublished report I wrote in 1937 on a "Review of Methods of Treating Ammonia Still Wastes", in which I had written, "Considerable work has been done in Russia on treatment with chlorine . . ." I'll have to ask Attmore (W & T) Griffin about that.—

★ ★ ★

So you're going to Miami next month to the 26th FSIWA annual meeting. If you haven't been there before, you might be interested to know that Florida is the place where:

—If you ask, "Is it going to rain?", you'll get the answer, "Nobody in Florida predicts the weather, but a fool—or a tourist!"

—You'll see trees you never heard of before like the Banyan tree, and half a dozen palm trees, including the Coconut, Cabbage, Sega (fern), Phoenix, Rotaling, Arica, Perotes and the Royal Palm, whose trunk looks like Transite Pipe.—(What? No Cast Iron?)

—Oranges, lemons, limes, etc., are common place, but the Mango, Papaya, Avacoda and Guava are more delicious.

—The flowers have a beauty all their own and a haunting fragrance you can't forget, like the Bougainvillea, Oleander, Gardenia, Croton, Pintus, Hibiscus, and that funny looking stick with the flowers on it, the Frangi-Pangi.

—You can catch fish such as pompano, blue fish, amberjack, channel bass, sea trout, marlin, sailfish, dolphin, tarpon, etc.

—The sewage problem is a long way from being solved but is progressing under the watchful eye of the one and only Dave Lee, Chief Sanitary Engr. of the State Health Dept.

—You'll get the sun in your eyes, the wind in your hair and "sand in your shoes", which is the native's way of saying you'll want to come back.

—and where—but you'll have to come to the FSIWA meeting on October 12th to find out for yourself.

★ ★ ★

John Musser, the man of many pipes, says that Flint, Mich., has every water works problem except six, those six being: Mississippi River mud; Minnesota and Wisconsin color; New England soft water; salt water intrusion; alkali water; and industrial waste pollution.—What's left, you ask?—"Plenty", says Musser.

★ ★ ★

New Notes from Brushy Bend —The 14th annual outing of the N. J. Sew. & Ind. Wastes Assn. will be held at Doerr's Grove, Livingston, N. J., on Sept. 26th.

—A Sanitary Engineering Group is being set up within the Metropolitan Section of ASCE. Alex Diachishin is Secy.-Treas.

—The Central Ohio Section of the Ohio Sew. & Ind. Was. Treat. Conf. will meet at the Cambridge State Hospital. The Welfare Dept. Operators short course is to be held the week of this meeting with Mr. Wittmer in charge.

—The Central Jersey Section of the N. J. Sew. & Ind. Was. Assn. elected

Anthony Franzoso as president at its July 1st meeting in Somerville. "Tony" is Supt. of Industrial Wastes Treatment at Johns-Manville Corp.

—The Ill. Sewage Treatment Operators enjoyed another bang-up meeting at their 18th annual conference in Springfield last March. Tom Gregory received the "distinkshun" of the SOWHESS award for having "fell in".

—The Northeastern Sect. of Ohio Sew. & Ind. Waste Treat. Conference will meet Sept. 17 at the Canton, Ohio, plant and on Oct. 29 at the Easterly Sewage Plant in Cleveland.

—Allentown, Pa. (and Harry Krum), dedicated its new filter plant on August 5.

V. T. Y.—Doc Symons

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Cross Connections

(*Continued from page 79*)

Usually, after the industry or business receives the letter, a conference is held between the plant engineer and the city's cross-connection inspector to discuss the method of elimination in the plant. The details are then worked out together. When the recommendations are complied with, the inspector makes a re-inspection of the plant and revises the schematic drawing, which is then filed until the next routine inspection.

An annual inventory report of all cross-connection hazards in the city is prepared and filed with the State Department of Health at the beginning of each year. This inventory tabulates each specific plant or location and the current status of the connections.

Summary of Work Done

In 1951, 1062 manhours were spent on this work and, in 1952, 940 manhours. Industrial violations found in 1951 numbered 41; and in 1952 there were 55. Including a 20 percent overhead charge, the industrial program cost $2317.93 in 1951 and $2070 in 1952, giving an average cost per plant of $27.27 and $23.52 for the two years. Residential violations aggregated 4 in 1951 and 3 in 1952, and involved 141 and 80 inspections respectively. The average cost, including overhead, per inspection was $1.52 and $2.13. The gross cost for residential inspections was $213.60 in 1951 and $170.40 in 1952.

For the most part, cooperation has been extended by industrial

plants and business establishments to the men responsible for the inspection. In 1951, 44 percent of the violations found were entirely eliminated and the remaining 56 percent were in the process of elimination and were completely eliminated during the year 1952. During 1952 inspections, 55 additional violations were found and were either eliminated or were in the process of elimination at the end of the year. This, however, does not mean that all cross-connections have been eliminated. The inspectors, each year, revise the schematic sketches and check for any cross-connection that may have been overlooked or that may have been installed since the last inspection.

It is impossible for the inspector to cover completely each and every plant in its entirety; therefore, it is essential to be able to explain the basic principles of hydraulics and the hazards of cross-connections to plant engineers. In several cases plant engineers or maintenance men have found additional cross-connections not discovered by our inspector and have notified the city and asked for advice in eliminating them.

It has been definitely proved that a cross-connection inspector, with an engineering background, well versed in basic hydraulics, is truly an asset in the promulgation of a good cross-connection program. Also, the interest and cooperation of the State Department of Health is essential and most helpful in setting up and carrying out the program.

Program Aids in Civil Defense

From the inspection records of industrial plants, a large map of the city was prepared locating deep wells that may be available in the event of a disaster, along with the depth of the well, type and capacity of the pump, whether or not chlorination equipment is available, and other pertinent data.

In the event of disaster, which causes a failure of the public water supply or seriously curtails the normal service of the waterworks system, the first need is for emergency water supplies to tide the city over until service can be restored in the affected areas.

During the winter of 1944-45, two large cities of this state suddenly found themselves without water. In both cases, war production of major importance was affected. One of the first steps taken was to search out possible sources of supply and the means for making such supplies available where needed. The State Department of Health records of cross-connection surveys proved to be the best place to look for possible sources which might be made quickly usable. The State's records were quite incomplete but in some cases yielded valuable information not quickly available locally. This information was followed up to verify details and steps were taken to make such emergency supplies available in a safe manner under the supervision of local waterworks personnel; however, much valuable time was lost in obtaining data which should have been readily at hand in the local water department records.

The information gathered by the Waterworks' Engineering section in the cross-connection program can be invaluable in such cases. The map referred to above and the accompanying tabulated and indexed notes will permit almost instant action to alleviate conditions resulting from enemy action, fire, flood or other emergencies of disaster proportions. The cost of making these data quickly available and useful is negligible after the detail surveys made in cross-connection control work are completed.

PUBLIC WORKS DIGESTS

THE HIGHWAY AND AIRPORT DIGEST

Hardening Properties of Asphaltic Materials

Among the factors that may cause the failure of a bituminous pavement, the hardening properties of the bituminous material are highly important. A quantitative knowledge of the tendency of an asphalt to harden is one of the indispensable measures in predicting the service behavior of a bituminous pavement. Investigations have shown that pavement failures increase when the penetration of the asphalt drops to certain critical values, which vary somewhat depending upon such factors as climate, flexibility of base and subgrade, and traffic conditions.

Several methods can be used for evaluating the hardening properties of asphaltic materials. The abrasion test and the weathering strength test are based upon the changes in the physical properties of standard sand-asphalt mixtures during exposure to heat and air. The thin-film oven test, developed by the B.P.R. for the same purpose, is more rapid and simpler and therefore is more suitable for use as a specification test.

From a study of the hardening of asphalts, engineers of the B.P.R. concluded that 1. Asphalts differ in their hardening properties, depending on the source of the crude petroleum and the methods used in their manufacture. 2. When subjected to weathering, cracked asphalts become hard and brittle more rapidly than do uncracked asphalts and also develop a higher degree of hardness and brittleness, the rate of hardening increasing with the degree of cracking. 3. Increase in hardness of the asphalt as indicated by decrease in penetration is accompanied by changes in other properties, such as increase in softening point and decrease in ductility.

"Studies of the Hardening Properties of Asphaltic Materials;" by Jarl T. Pauls, Chf. Bit. Section, and J. York Welborn, Research Engr., B.P.R. *Public Roads*, August.

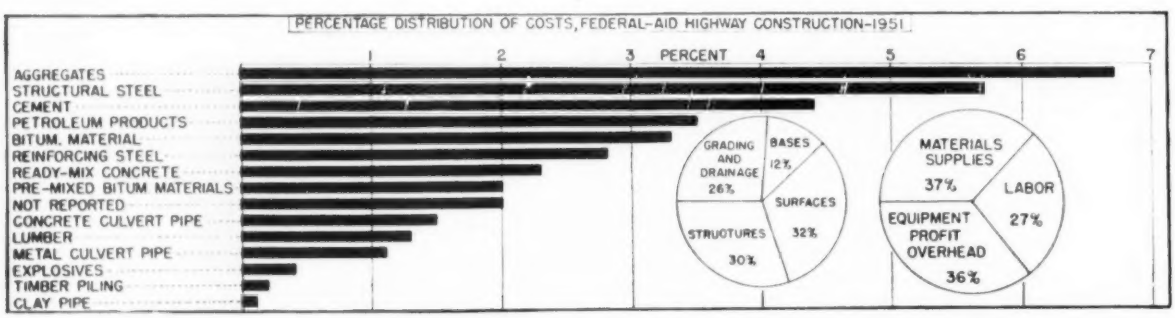
Carrying Heavy Traffic After 30 Years

A 5.2 mile length of U. S. Route 60, running east from Richmond, Va., known as the Seven Pines Road, is an excellent illustration of adapting a pavement progressively for continually increasing traffic. Previous to 1924 the surface had been a thin layer of untreated gravel. That year gravel was added to give a minimum thickness of 4 in., and on this was placed a 4-in. hot-mix asphaltic concrete base and 1½ in. of sheet asphalt top. By 1927 it was carrying over 2500 vehicles daily. In 1934 it was widened, using for the new foundation 8 in. of reinforced concrete, covered with a 1½-in. sheet asphalt top. In 1939 it was smoothed by placement of an open-graded cold-mix asphalt averaging 1 in. in thickness. To provide for the very heavy volume of traffic then using it, in 1946 it was resurfaced with 2¼ in. of hot-mix asphaltic paving. The pavement now is of 3-lane capacity, and has a total thickness of 12 in.; it is stronger and smoother than ever, and the total cost has been less per sq. yd. than for a totally new pavement today.

"Virginia's Seven Pines Road After 30 Years;" *Asphalt Institute Quarterly*, July.

Alternate Bids on State Highway Work

Of 42 state highway departments replying to a questionnaire asking whether they take alternate bids on highway contracts, 37 reported no limitation on engineer's decision on paving type; 20 that alternate designs are usually (or sometimes) estimated as part of the design procedure; 8 reported that bids are usually (or sometimes) taken on alternate types, but not required by law or court ruling. In one state alternate designs are required. Typical replies were: "We consider



● THIS CHART was prepared by ARBA from data furnished by Bureau of Public Roads.

"BEST MACHINE MADE FOR PLOWING AND MAINTENANCE"

One of James E. Barsness' No. 12 Motor Graders plowing near Glenwood, Minn. Also in the Barsness "stable" are five Cat D8 Tractors, one D7, two D4s, two No. 80 Scrapers and a Cat HT4 Shovel.

TAKE it from James E. Barsness, Glenwood, Minn., contractor. Caterpillar Motor Graders are "the best rig you can find for plowing snow, for road maintenance and for other summer jobs."

Just look what these graders do for Mr. Barsness and Pope County and you'll see why he's so enthusiastic: equipped with Caterpillar Snow Plows and Snow Wings, two Cat* No. 12 Motor Graders clear drifted snow from 110 miles of county roads per day. During the same 12-hour period they plow out 10 acres of parking area! In summer, Mr. Barsness removes the plows and wings from his motor graders and goes to work building and maintaining the same roads.

Versatile Cat Motor Graders can work wonders for your county, too, on a year-round basis. All major components are Caterpillar-designed and built: weight, power and speed are *balanced* for top performance. Tandem drive provides constant power delivery and traction. The operator can see the blade, the road and the job at all times, and he can change blade positions quickly *from the cab.*

Call your Caterpillar Dealer for further information, and an on-the-job demonstration.

Caterpillar Tractor Co., Peoria, Illinois.

CATERPILLAR*

*Both Cat and Caterpillar are registered trademarks—®

NAME THE DATE... YOUR DEALER WILL DEMONSTRATE

various designs and take alternate bids frequently as a matter of economy and to provide more competition in bidding." "We feel the pavement choice should be based on an economic evaluation by the engineers and not by salesmen."

"Some States Take Alternate Bids, Some Don't." *Roads and Streets,* July.

Missouri's Job Flagging System

A standardized system of signing, flags and flagging, to warn motorists of work under way on Missouri highways soon will be put into effect throughout the state as a cooperative project of the State Highway Commission and the Associated General Contractors of Missouri. The program aims to provide more adequate warnings to motorists at points adjacent to highway work; also to eliminate delapidated warning devices that have been so prominent. A motorist approaching, passing and leaving a job will pass a succession of signs: *"Missouri Moves Forward. This Highway Improvement Is for Your Future Safety and Convenience."* Then *"Please Drive Carefully Next — Miles,"* with a statement of the kind of work being done. Next comes: *"Road Construction, Slow,"* followed by a sign identifying exactly what work is being done, such as *"Fresh Oil"*. On leaving the work he will see *"End of Improvement. Thank You For Your Patience"*; and finally *"Resume Speed, Thank You"*. Signs will be night reflectorized. Most of them will carry one or two red warning flags. "Job Flagging and Signing System." *Roads and Streets,* July.

Off-Center Laning Increases Street Capacity

Los Angeles, Calif. has about 24 miles of streets which use off-center laning during peak flows. These are major thoroughfares where use of permanent one-way traffic is not practicable, nor temporary one-way traffic feasible. Twelve 2-man teams, each with a ¾-ton pick-up carrying about 300 rubber cones, place cones and movable signs so as to designate one or more central lanes for use by cars traveling in the direction which will be taken by the heavier flow of traffic during the next peak period; then, at the end of this period, the cones are picked up, to be replaced before the following peak to favor the heavy traffic in the opposite direction. Thus a 6-lane road, using 4 lanes for the heavier traffic, has, in effect, the capacity of an 8-lane. Not only are more lanes available, but the speed in the off-center sections of Olympic Boulevard increased from the average of 18.4 mph on uncontrolled streets to 22.5 mph. For full benefit, off-centering is combined with parking prohibited; use of a cable-connected 3-dial timer signal system; off-centering of some tributary streets; and left turns prohibited where they would cause unusual delays.

"Off-Center Laning Adds More Street Capacity in Los Angeles;" by James Joseph. *Roads and Streets,* July.

Snow Handling On the Streets of Syracuse

Syracuse, N. Y., Com'r of Pub. Wks. believes they have developed a system for keeping their 397 miles of streets in as near "Florida" condition in winter as is humanly possible. Some streets require six passes of a plow to remove all the snow, some five, some only two; altogether 1600 miles of street lanes

to be plowed. When a storm begins, salting is started at once; and plowing starts when 3 in. has fallen, the preceding salting making it easy to leave a perfectly clean pavement. No abrasives are used with the salt. The city subscribes to a weather information service and also has a local weather service. When a storm seems imminent, the general foreman of the department force is notified, and 30 min. before it is due to start he sends the snow and ice equipment to the central garage, where it is loaded and prepared for action. Most storms break in mid-afternoon, and the 8 to 5 shift is used to handle it; working, if necessary, until the 11 P. M. shift comes on. Parked cars give trouble, and the Police Dept. sometimes tows away 50 or 60 cars to permit snow removal along the curbs. The main arterials are plowed from the curbs to a windrow in the center of the street.

Salting on flat streets is used only at stop lights and stop streets. Grades are salted in 30 ft. stretches alternating with 30 ft. unsalted stretches, relying on the carry-over from the salted stretches to take care of the latter. For salting, they have 5 large Walter spreaders of 7 tons salt capacity and 24 smaller trucks with Scotchman spreaders on the tail gate. When a 3-in. or 4-in. snow fall is immediately preceded by freezing rain or sleet, small rear-end spreaders attached to snow plow distribute salt on the ice uncovered by the plow. Their equipment includes 33 center-scraper type Walter trucks; 15 one-way plows mountable on Walter trucks; a "Sno-Go" loader, a "Hi-Loader", and 3 old track-type Barber-Greenes.

"How to Get 'Florida' Streets in the Winter;" by Frank F. Harmon, Com'r. of Pub. Wks. *PUBLIC WORKS*, August.

Snow Control on Roads of Northern New York

Saratoga County, N. Y. contains 351 miles of county roads and 218 miles of state highways, on all of which the county is responsible for snow and ice control. The average snowfall is from 60 to 120 in. annually, some storms reaching 24 ins. They use approximately 3,000 tons of CC grade rock salt a year, generally without abrasives; but there are times and places where abrasives are considered to be necessary, and a considerable amount of them are stockpiled at two of the county's garages. When the temperature is above 20°, the spreading of clear salt at about 400 lb. per mile starts at the beginning of the storm; plowing being delayed until about 4 in. of snow has fallen. Where plowing has left any snow packed on the pavement, a light application of salt is made. When the temperature is below 20°, plowing is started at about 2 in. of snow. When plowing has been completed (usually leaving a thin film on the pavement), abrasives mixed with chemicals are applied; and if the temperature rises within the next day or so, clear rock salt is applied. They have 10 2-way radio units installed on trucks operating in strategic locations. Their equipment comprises 90 trucks, 9 shovels, 7 bulldozers, 12 power graders, 2 Sno-Go units, 12 sanding bodies, 14 salt machines, 75 sand spreaders, 3 belt conveyors, 1 Hydrocrane and one ½ yd. truck crane. The Sno-Go units are used to clean up intersections and cut back banks off the shoulders.

"Snow and Ice Control in Upstate New York;" by F. Ray Williams, Co. Supt. of H'ways. *PUBLIC WORKS*, August.

Subsealing Concrete Pavements with Emulsion

J. M. LEWIS,

Sales Engineer, American Bitumuls & Asphalt Company

A high-speed, labor-saving method of subsealing concrete pavements by means of forcing emulsified asphalt under the pavement at atmospheric temperature has been developed by the maintenance department of the New York State Department of Public Works. Like other states throughout the country, New York has, in isolated locations, many miles of old concrete pavements resurfaced with bituminous concrete. Under adverse subsurface conditions, these break up and start pumping. Formerly, these areas were repaired by removing the old black top and replacing with new. Where the old concrete was completely broken, it was necessary to remove the entire area to a depth of about two feet and replace with concrete or crushed stone base.

This procedure proved costly and in many cases was not entirely satisfactory. Even when work was done with great care, and adequate drainage outlets were installed, it was found that the pavement would continue to break either in the same spot or adjacent to the old break.

Lately, the state has begun repairing this type of break and preventing subsequent pumping by drilling a hole through the bituminous concrete and the concrete base and pumping asphalt emulsion under 10 to 15 pounds pressure into the hole. In many cases, some holes have received over 50 gallons of material. After the holes have been filled, any material that may have escaped is broomed about and covered with stone chips. The holes are then plugged with wooden pegs, cut off flush with the pavement. Tapered injection nozzle fittings which have four threads to the inch and can be jam-locked in place are used to reduce the escape of emulsion.

This sealing technique stabilizes the underlying soil and fills the voids and cracks in the broken concrete base. It also furnishes a new tack coat between the black top and the concrete. The material used is a "quick breaking" type of emulsified asphalt, substantially ASSHO Spec. RS-1 and RS-2 N. Y. State Spec. Items 70B and 70B Grade C.

In the first use of this method, the asphalt was applied by pouring pots to open joints and cracks and through holes drilled in the pavement. Soon it was introduced under pressure, using a Tarrant drum sprayer at 20 to 30 pounds pressure, or with the conventional truck distributor. As the procedure was developed, and where the width of expansion joints permitted, holes were driven down through expansion-joint material and a small pipe nozzle was inserted through which the emulsion was forced under the pavement slab for subsealing and for filling the joints from below. This eliminated the time involved in drilling holes through the pavement.

With each of the above variations on the method, pouring was stopped when free emulsion appeared at the pavement surface. The emulsion was permitted to harden for one or two days when the operation was repeated if necessary to complete the filling. When more than 50 gallons of material were required, the operation was discontinued temporarily and started again within a few days. Top pouring of joints to complete filling was done as necessary.

● **PUMPING CREW** forcing emulsified asphalt through drilled holes.

● **INJECTION NOZZLE** about to be inserted in hole which was drilled previously through the pavement.

● **INJECTION NOZZLE** removed and hole plugged immediately with wooden peg to stop flow of emulsion.

Aerial Photography

(Continued from page 76)

taining information from aerial photographs, and one that has many applications in highway studies, is photogrammetry. Photogrammetry is the science of obtaining horizontal and vertical measurements from photographs. In highway work, photogrammetry has its particular place in preliminary and final location surveys for by this method topographic and planimetric maps are prepared from vertical aerial photographs. Photogrammetry and photogrammetric engineering are specialist operations, and trained professional personnel and elaborate stereo-plotting instruments are a necessity. Good ground control is also a requirement, and its availability will have direct effect on the cost of the mapping.

Photogrammetry has two important phases in highway studies: it provides new large scale photographs along a proposed location for photo reading and photo interpretation studies, and from these photographs topographic maps with two or five-foot contour intervals can be prepared covering a much wider band of terrain than would be economically feasible by field surveys. Photogrammetric methods also produce results in about one-fifth the time.

Photogrammetry not only has application in location studies, but also, once the location is fixed, special large scale photographs of 200 to 400 feet per inch can be secured of proposed bridge sites, traffic interchanges and grade separations. From these photographs, topographic maps with one or two-foot contour intervals can be prepared using only a small number of ground control stations. Invariably this method will save time and money if there are numerous such surveys to make along a route.

The writer feels that photogrammetry is one method that can be used effectively by highway departments to secure basic topographic surveys at hazardous narrow bridges which need to be relocated and reconstructed. Basic ground control usually is available at such sites; therefore, by placing a cross or other symbol around such points and establishing a few other horizontal and vertical ground control points that can be identified on large scale photographs (and that meet the standards set up by the highway department in conference with photogrammetric engineers), the field survey party can confine their field work to securing data on foundation material, stream profile characteristics, high water stage, scour and other pertinent data pertaining to bridge design. The aerial photographer can then procure photos of twenty to thirty bridge sites in any one highway district in one day and topographic maps can be prepared by photogrammetric methods. The contour interval that can be obtained and final map scale to be used is dependent upon many factors such as: flight altitude, type of stereoplotting instrument, camera focal length, ground control, terrain, flight obstacles, and vegetation. Many of these factors can be controlled or evaluated by the photogrammetric engineers. The factor of vegetation is of primary concern in mapping at a one-foot contour interval, and, because of this, it may not be possible to map all bridge sites by photogrammetric methods. This may be overcome to some extent by mapping at a two-foot interval from late fall pictures. Cost figures of a photogrammetric project outlined above are not available and the writer is not familiar with a direct

application of such procedures by a highway department on a state wide basis. It would appear, however, that if fifty to seventy-five bridge site projects could be planned in advance by consulting with photogrammetric engineers, photogrammetric methods would save considerable time and money in securing basic design information and enable highway departments to relocate more bridges than it is possible for them to do by using their limited number of field parties.

Summary

Photo reading, photo interpretation and photogrammetry each have their particular application in furnishing basic information for use in preparing drainage, soils, planimetric, and topographic maps. The techniques can be applied to various stages in the development of comprehensive highway studies. Photo reading and photo interpretation can be applied to reconnaissance and preliminary highway studies. Photo reading is mainly applicable to studies of alignment, right-of-way, land use, and watersheds. Photo interpretation is applicable to an evaluation of soil-parent material areas, location of possible borrow materials, and adjustments in alignment to avoid poor soil.

Photogrammetry can be applied to preliminary highway location studies and also, with certain limitations, to final location surveys. Topographic maps at two- or five-foot contour intervals prepared by photogrammetric methods to meet National Standards of Map Accuracy cover a much wider band of terrain than it is feasible to secure by ordinary field surveys. This enables the highway engineer to compare several routes to secure the best alignment and grade at least cost.

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St. Paul Snow

(Continued from page 69)

Plows are operated in batteries of two or three arranged in echelon, thus completing the plowing operation in one trip on each side of the street. On University Avenue with its 95-ft. roadway and pedestrian islands, five or six plows are at times operated in echelon. In case of an extremely heavy snow storm or several moderate snowfalls in succession, the accumulated snow along the sides of streets must be pushed back by special equipment, such as a taper straight blade plow, a tractor mounted "V" plow, or motor grader. A special gasoline "nurse" truck is kept on duty to supply the units with gas, oil and incidental supplies. Towing service is available for bringing in equipment requiring repairs. For safety a special blue road light of distinctive appearance is mounted on each side of the cab in front, as high as possible, in addition to the regular head lights and a similar single light in the rear.

Alleys are not plowed on account of the additional expense involved and the difficulties incurred in blocking private garage entrances. The plowing of drifts in residential areas creates quite a problem for each individual householder at private driveways. A city ordinance requires that property owners remove snow promptly from public sidewalks abutting their property.

The Minnesota Highway Department plows about five miles of limited access divided highways within the city limits with the city plowing the service roads. Ramsey County plows several of the joint city-limit roads. In order to lessen the hindrance to plowing from parked cars and still give nearby space for parking, the city is considering a plan

for the plowing of north-south streets one day and east-west streets the following day. While there are some difficulties to be ironed out in an arrangement of this kind, it has the possibility of giving advance notice to property owners as to what the plowing plan will be.

Snow Removal and Disposal

It is necessary that all snow be entirely removed as soon as possible after it falls from streets and sidewalks in the central business district, from streets in neighborhood business districts, from several of the major traffic thoroughfares, and from bridges and other special areas. Under average conditions snow is loaded and removed from about 65 miles of streets including the 24 miles in the loop. This work, particularly in the central business or loop district, is done between 10:00 P.M. and 8:00 A.M. As a rule sidewalks are cleared by evening and the snow pushed into the gutter so that a complete job may be done. Snow is plowed from the center of the roadway to each side and is bladed by motor grader from the curb out into a windrow. Loading into trucks is by the SnoGo, Athey, or Sicard units. The number of trucks assigned to each unit varies with the capacity of the loader and the length of haul. For an 8-in. snow, two nights' work is required for the central loop district. Removal work in the outlying business districts may be done during daylight hours.

The parking of cars on streets from which snow is to be removed presents a difficult problem for both mechanical and hand removal. The radio and press are utilized to the fullest extent in publicizing information as to areas and times of snow removal with the request that vehicles be removed from these areas during the stated time. The Police Department cooperates to the fullest extent in carrying out these no parking requests. Where cars do remain on the street, they are hauled by tow trucks to another area. Careful consideration is being given to the passage of an ordinance requiring both the payment of a fine and the towing charge for parking in an area restricted for snow removal. The legal difficulty is to make certain that adequate notice is given to the public for such snow removal. Temporarily placed placards or signs carrying the wording "No Parking after 10:00 P.M.—Snow Removal—Police Department" and "No Parking in this block 7:00 A.M. to 2:00 P.M." are used in such areas and also on streets to be plowed.

Snow from bridges is either removed by loading or by blowing or shoveling over the railing. Although every possible use is made of mechanized equipment, hand labor is required occasionally for loading of snow at intersections and for inaccessible places and for opening of catchbasin inlets. Front end loaders, such as the Hough and Lull, as well as tractor-bulldozers are now being used extensively for loading snow at intersections and at alley entrances. Snow from private areas, such as parking lots, filling stations, etc, must be removed privately and not deposited in the street area.

Disposal of snow is becoming increasingly more difficult as the mileage of streets requiring complete removal increases. At the present time disposal is in two especially constructed sewer manhole shafts, in vacant lots, city dumps and to a limited extent in the Mississippi River. A supplementary water supply is installed in each of the manhole shafts to facilitate the melting and breaking up of the snow. As vacant property becomes developed and dumps are closed, the disposal areas become reduced and the required haul longer.

Ice control requires a substantial portion of total expenditures. Irrespective of how close a street is plowed, there is a time, before the pavement surface becomes bare, that an icy surface may form. The same is true with a light snow. On country highways the light snows or snow covering is whipped off by the fast moving traffic. On city streets the snow remains in place and many times compacts into a thin layer of ice. The turning of rain into sleet or snow results in the same hazardous condition. These icy conditions must be remedied by the spreading of abrasives mixed with enough chloride to cut the icy surface and imbed the abrasive. Up to about five years ago the city was able to obtain sufficient cinders to serve its needs. Due to the present shortage of cinders we are now using sand entirely. This is purchased from commercial aggregate producers and stock piled during the summer. During the 1952-53 snow season the city purchased 17,500 tons of sand at a cost of $1.25 per ton delivered, or $0.78 city to haul; 2,880 tons of salt at a cost of $14.80 per ton; and 40 tons of calcium chloride at a cost of about $29.00 per ton. About 50 pounds of salt per ton is mixed with the sand to prevent freezing in the stock piles and some additional salt is added before placing the sand on the street. On streets in the central business district and on several other heavy traffic streets it has been necessary to use chlorides on a sufficiently large scale to break up ice and at least keep the pavements partially bare.

The sand spreading trucks are equipped with standard sand spreaders, such as are used for

spreading sand during the summer on oiled streets. Sand is loaded from the stock piles into the trucks by front end loaders. Particular attention is given to the prompt alerting of sand crews to meet icy conditions which frequently develop rapidly so that serious traffic tieups result.

While snow fences are not widely used to prevent drifts from forming on city streets, the department has about 8 miles of the slat type fence and places these in outlying districts and residential areas where experience has shown drifting to be prevalent. These fences, properly placed, help to keep the drifting under control.

Such sand as is not removed during the plowing and snow removal operation remains on the streets and in the gutter until spring when it must be removed as a street cleaning operation. Due to the large quantities of material involved, the program of regular street cleaning is seriously interfered with for a time. At least a portion of this cost of spring cleaning of streets and bridges should properly be charged to the snow plowing and removal operation. It may be noted that sand once spread on the streets cannot be reused as the abrasive qualities are lost. It is impracticable to flush the sand into sewers with water as it would clog the catchbasins as well as the sewers which have flat grades.

Daily reports are made by the operators and foreman. These are consolidated without delay by the accounting office so that a running account of snow costs is continually available. Table 2 shows the costs of the three principal items of snow plowing, removal and ice control for certain years. Table 3 shows relative costs of labor and equipment rentals. The amounts in Table 2 include the cost of new equipment as of the time purchased. The rental rates for city equipment set up in Table 3 are for standard units which are also used on street maintenance and other types of city work.

Increasing demands for service taken with increased operating costs and an expanding mileage of streets accounts for the increasing trend in costs over this period of years. An additional burden to the city operation is the complete plowing of former street railway track areas which before the changeover to buses was plowed by the Street Railway Company with its own equipment. The use of sand in place of cinders has increased the cost of ice control as formerly cinders were obtained for the hauling, the crushing and screening costs being relatively low.

Cooperation of the public can greatly aid in snow plowing and removal work. In cases of heavy snow or icy conditions, cars should be kept at home unless equipped with chains. Sidewalks, particularly areas where complete snow removal is required, should be cleaned promptly. Care should be taken not to park cars in areas posted for plowing or snow removal. Such cooperation will not only reduce plowing and removal costs, but will give a much better job. On streets with narrow roadways, parked cars require that the plows swing out to pass the cars, leaving in many cases a space only wide enough for a vehicle moving in one direction. For snow loading it is essential that the street be free of vehicles so that the snow may be removed to the curb line.

Within the tenure of many of the personnel of our snow forces, snow and ice control has advanced from a minor to a major municipal function. Thirty years ago the Street Railway Company kept its transportation system going during heavy

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snows with its own track plows. These plows were equipped with wings which also plowed part of the street. The city followed in opening up streets with inadequate plowing equipment as compared to present standards. Snow removal was confined to hand loading by large crews of men hired for the emergency. Little attempt was made to correct icy conditions.

Since then equipment and operating technique has been gradually perfected until now the process is fairly well mechanized. Traffic and business continues normally even through the most severe snow storms with very little inconvenience. It is taken for granted that the necessary services will be rendered even though at greatly increased costs. City governments are faced with an increasing number of requests for the extension of the areas of complete snow removal as well as for the plowing of the streets in a shorter period and for more complete coverage for ice control. All of these increased services, if granted, require more equipment, prompt replacement of old and obsolete machines, adequate maintenance and operating personnel, and sufficient housing for storage and repairs.

Frank D. Marzitelli is Commissioner of Public Works. John M. Cotter is Superintendent of Sanitation. John P. Gleason is Supervisor of Street Maintenance. Arthur H. Koch is Superintendent of the Municipal Equipment Bureau and Walter Einck is Equipment Dispatcher.

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Industrial Waste Problems

(Continued from page 64)

Gering, Grand Island, Hastings, McCook and Wayne. *New Hampshire:* No problem: Concord, Laconia, Manchester, Meredith, Newport and Rochester. *New Jersey:* No problem: Chatham, Livingston, Metuchen, Morristown, Phillipsburg (which has 6 industries), Scotch Plains, South Orange, Teaneck and Tenafly. *New Mexico:* No problem: Deming, Lordsburg, Santa Fe and Tucumcari.

New York: No problem: Beacon, Canandaigua, Corinth, Fort Edward, Freeport, Fulton, Greenburgh, Johnson City, Kingston, Lynbrook, Malverne, Mamaroneck, Mt. Vernon, Pleasantville, Port Jervis, Riverhead, Solvay, Watertown and Williamsville. Data are not available on the New York City situation. *North*

Carolina: No problem: Beaufort, Dunn, Kings Mountain (a problem but no data), Lumberton, and Rocky Mount. Data are unavailable on the Winston-Salem situation. *North Dakota:* No problem at Devils Lake.

Ohio: No problem: Lakewood, Maple Heights, Oberlin, Springfield (data incomplete), Swanton, University Heights and Xenia. *Oklahoma:* No problem at Ada, Blackwell, Clinton, Drumright, Elk City (2 industries, no problem), Fairview, Lawton (2 industries, no problem), McAlester, Midwest City (3 industries, no problem), Muslogee, Okmulgee and Tonkowa. *Oregon:* No problem: Baker, Klamath Falls, La Grande, Lakeview, Pendleton (3 industries, no problem), Roseburg, Sweet Home and The Dalles.

Pennsylvania: No problem: Abington, Ashland, Baden, Beaver Falls, Bellefonte, Bristol, Carlisle, Clarion, Clearfield, Dormont, Doylestown, Edgewood, Ford City, Grove City, Hazleton, Highspire, Lock Haven, Marble, Mt. Penn, Radnor, State College, Weatherly, Wellsboro, Wesleyville and Wyomissing. *Rhode Island:* Surveys are now being made of the Providence situation, where industrial wastes present a problem.

South Carolina: No problem: Chester and Florence. *South Dakota:* No problem: Mitchell, Spearfish and Yankton. *Tennessee:* No problem: Cleveland and Johnson City. *Texas:* No problem: Amarillo, Austin, Baytown, Bellaire, Big Springs, Bryan, Carrizo Springs, Carthage, Coleman, Dalhart, Denison, Eagle Pass, Ft. Stockton, Lake Jackson, Lamesa, Littlefield, Livingston, Nacogdoches, Orange, Pampa, Port Neches, River Oaks, Sulphur Springs, Texarkana, Vernon and Wichita Falls.

Utah: No problem: Ogden or Panguitch. *Vermont:* No problem: Hartford, Middlebury and Swanton Village. *Virginia:* No problem: Abingdon, Blacksburg, Franklin and Galax. Buena Vista, with 3 industries, may have a problem later. *Washington:* No problem: Hoquiam, Port Townsend, Pullman and Raymond. Situation at Wenatchee is not known. *West Virginia:* No problem: Clarksburg, Morgantown, Philippi, Richwood and Williamstown. *Wisconsin:* No problem: Beaver Dam, Beloit, Fox Point, Hurley, Jefferson, Kaukauna, Marshfield, Superior, Two Rivers and Wausau. Dilution is presently able to handle the problem at Cudahy. *Wyoming:* No problem: Cody, Lander and Powell.

Public Works EQUIPMENT NEWS

Truck Crane is Adaptable to Many City-County Jobs

With four easily interchangeable attachments—dragline, shovel, crane and trenchhoe—this $^3/_8$-yd. capacity truck crane can be used to save labor and reduce costs on: Trenching, laying pipe, unloading cars, backfilling, feeding gravel plants, placing concrete, driving piling, loading snow, and similar kinds of work. The unit is well designed with a roomy cab which affords the operator full view of the work being done at all times. Controls are handy.

Sargent "four-in-one"

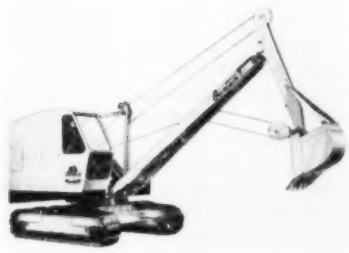
Complete information can be obtained from Sargent Engineering, Inc., Fort Dodge, Iowa.

Use Coupon on page 32; circle No. 9-1

Self-Loading Truck Crane Speeds Material Handling

This unit converts a truck into a self-loading crane; installation is simple. It comes in two models—one with an elevating mast, the other with a "fold-over" superstructure. Available in a wide range of sizes, from $^1/_2$ to 2-ton capacity, these loaders are adaptable for use in all types of construction and utility work. Full details from Ray-Lind Mfg. Co., Iron River, Mich.

Use coupon on page 32; circle No. 9-2



New Schield Bantam Shovel

New Crawler Type Shovel Crane Has 3/8-Yd. Capacity

The $^3/_8$-yard, 5-ton rated crawler-mounted line of cranes, back-hoes, drag-lines, shovels, clam-shells, pile drivers and magnet cranes has just been announced. This Model C-35 has an overall width of 94 inches thus meeting highway transportation requirements without special road permits. Cab is designed for operator comfort and efficiency. Full details from Schield Bantam Company, Waverly, Iowa.

Use coupon on page 32; circle No. 9-3

Oiler and Filter for Lubricating Pneumatic Tools

This oiler automatically lubricates pneumatic tools with "oiled air." Neoprene shock-absorber mountings permit dragging without damage; non-breakable window shows when oil supply is low. Adaptable to all standard size air lines. Constructed of aluminum; has no moving working parts; oil flow can be adjusted to desired requirements. Air-Speed Tool Co., 1502 W. Slauson Ave., Los Angeles 47, Calif.

Use coupon on page 32; circle No. 9-4

Shelter Sign for Civilian Defense and Other Uses

A shelter sign, which should be of interest to civilian defense, industrial and municipal organizations, has been developed by the Halco Co., 165 Dwight St., New Haven, Conn. This can be permanently affixed to any smooth surface without use of tools, tacks, water, glue, etc. Signs are furnished in two parts, making it possible to point in any direction. More data from the manufacturer.

Use coupon on page 32; circle No. 9-5

Suction Machine Gathers Leaves and Trash from Roadside

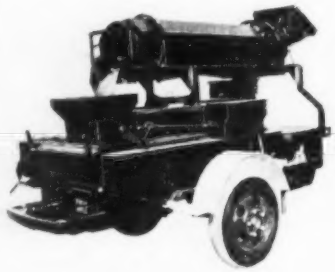
This new Leaf-Eater is used for cleaning streets, parks, cemeteries, highways and other public places. The unit may be mounted on a truck or towed by a tractor. It has a 12-inch snout which is operated by a man riding a special seat beside the hopper. It sucks leaves, paper, tin cans, bottles and other trash into a 14-yard capacity hopper. A four-cylinder industrial engine supplies the power. The hopper is dumped easily and quickly by a hydraulic unit. More from Omaha Body and Equipment Co., 24th and Vinton St., Omaha, Nebraska.

Picks up roadside trash

Use coupon on page 32; circle No. 9-6

Portable Asphalt Plant for Producing Patching Material

This machine is designed to produce accurately proportioned hot-patch bituminous concrete on the job. The Patchmobile PM 215 features a 7-foot rotary dryer; 165-



Wylie asphalt patcher

gallon asphalt tank; 54-inch long pug-mill mixer with 30 blades; power asphalt pump with spray attachment; asphalt measuring device; and a tool heating compartment all in one packaged unit. Only additional equipment needed is a dump truck for hauling and towing. Complete data from Wylie Mfg. Co., Box 7086, Oklahoma City 12, Oklahoma.

Use coupon on page 32, circle No. 9-7

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New Open End Wrench for use on Water Meter Fittings

The TAC open end ratchet wrench reaches down and around fittings and then ratchets "on" or "off" without removing until completion of the work. Handle swing clearance of as little as 5 degrees will operate the ratcheting head. The gripping surfaces engage five sides of a hexagonal fitting. Wrench is available in all sizes up to four inches. More information from Tubing Appliance Co., 10321 Anza Ave., Los Angeles 45, California.

Use coupon on page 32; circle No. 9-8

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Front-Mounted Swing Trenching and Ditching Machine

Especially adapted for pipe-line trenching, handling and laying pipe,

The Wagner swing trencher

tree planting and the numerous other jobs requiring handling of heavy material or equipment, this swing trencher can be readily converted to a heavy-duty loader by the addition of a standard dipperstick assembly. The boom has a lateral swing of 30° right or left of the trench and dumps high enough to load trucks. It fits the most popular makes of wheel and crawler tractors. Complete hydraulic controls. More information from Wagner Iron Works, 1905 South First St., Milwaukee, Wisconsin.

Use coupon on page 32; circle No. 9-9

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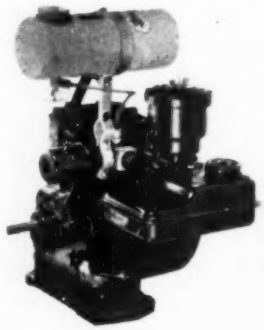
Insecticide Fog Unit is Quick Death to Insects

Ejecting an insecticide that is quick death to mosquitoes, flies and other insect pests, this fogging machine eliminates costly hand spray-



Insect control fogger

ing and is easy and economical to operate. Spray is emitted in the form of a penetrating fog. The unit is powered by a Briggs & Stratton one hp engine and weighs only 30 pounds. It may be mounted on skids or on wheels. More from Brulin & Co., 2939 Columbia Ave., Indianapolis, Ind.

Use coupon on page 32; circle No. 9-10

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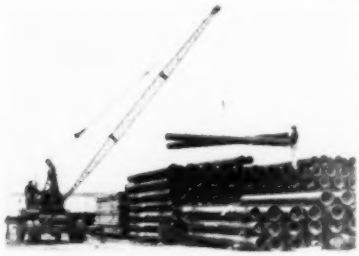
High-Pressure Steam Cleaner for Construction Jobs

A new high-pressure steam cleaner has been announced by Hypressure Jenny Div. of Homestead Valve Mfg. Co., Coraopolis, Pa. This is particularly useful to road-building and construction contractors because of its ability to roll over rough ground. A full-powered blast can be delivered in 90 seconds and controls permit the operator to start and stop unit at the job, 100 feet or more from the Jenny. Vapor spray output 90 gals. per hour; also comes in 120 gals. Full details from manufacturer.

Use coupon on page 32; circle No. 9-11

Truck Mounted Power Crane is Handy for Many Jobs

Designed for installation on trucks of 2½ tons capacity or larger, this Model 80 Pitman crane has a



Pitman crane handling pipe

capacity of four tons on a 25-ft. boom; and additional boom lengths up to 59 ft. are available. Controls provide precision operation, valuable in many kinds of work. Ability to use the truck for other purposes, quick set-up time and general handiness are added advantages. A fifth wheel on the subframe permits the truck to haul a trailer. Pitman Mfg. Co., 300 West 79th Terrace, Kansas City, Mo.

Use coupon on page 32; circle No. 9-12

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Rat Poison Makes Baits Last Longer

Pival, a rodenticide made by Motomoc, Inc., 10 Murray St., New York 7, N. Y., is unique in that it has insecticidal and fungicidal activities. Used in low amounts, lethal effect depends upon multiple feedings of small quantities over a period of days, with minimum hazard to humans, domestic animals and pets. It takes an average of 6 to 10 days to kill rodents; in 2 or 3 weeks whole colonies are destroyed. Baits are resistant to insect infestation and mold contamination. More data from the manufacturer.

Use coupon on page 32; circle No. 9-13

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Half-Yard Excavator with 10-ton Lift Capacity

This machine is a newly designed crawler mounted excavator. Model 205 has a simplified upper machinery arrangement that involves only two horizontal shafts. Other features are fully enclosed gears, automatic brakes, a new cab design and operating lever arrangement, adjustable hook rollers and an electrically operated dipper trip. More information can be had from the Koehring Company, Milwaukee 16, Wisconsin.

Use coupon on page 32; circle No. 9-14

New Mobile Radio Equipment Utilizes Additional Channels

Expansion of two-way radio service by the use of newly released UHF channels is made possible by the development of a new mobile transmitter-receiver unit. As many as 80 new channels of communication in the 450 to 470-megacycle portion of the spectrum are now available for such agencies as police and fire departments, domestic public services, industrial fleets etc. More data from RCA Victor, Camden, New Jersey.

Use coupon on page 32; circle No. 9-15

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New Hydraulic Control Concrete Saw for Pavement Cutting

Featured in this new concrete saw is hydraulic control for lowering the blade. The operator can lower the blade gently into the cut at a

Briksaw cutting pavement

controlled rate of speed. Thus the blade will not be dropped or bounced against the material. There is a dual shaft so that the blade can be placed at either side for sawing in corners or confined areas. More from Eveready Bricksaw Co., Dept. 347, 1509 S. Michigan Ave., Chicago, Illinois.

Use coupon on page 32; circle No. 9-16

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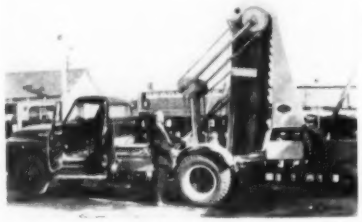
Compact, Light-Weight Single-Cylinder Engine

Designed for intermittent and continuous operation using gasoline, kerosene or gas fuels, this compact engine develops 5 to 10 hp and has a speed range of 500 to 1200 rpm. It is single-cylinder, 4-cycle, water-cooled and can be used for lighting plants, pumping, compressors, concrete mixers and welding sets. Piston is aluminum. Data from Witte Engine Works, 1600 Oakland Ave., Kansas City 26, Mo.

Use coupon on page 32; circle No. 9-17

Truck-Mounted Ditching Machine with Jack Knife Boom

The truck-mounted Earthripper ditching machine features a jack knife boom that is raised and lowered hydraulically. The bucket line can be extended at an angle to start the ditch flush against walls



Digs trenches to 6 ft. deep.

or curbs. The standard machine digs ditches from 8 inches to 24 inches wide and up to 6 feet deep. The ditcher is driven by the truck motor through an improved transmission. Digging speeds are from one to 44 feet per minute. Complete information obtainable from Owen Pewthers Manufacturing Company, College Station, Texas.

Use coupon on page 32; circle No. 9-18

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Power Driven Post Hole Digging Machine Cuts Costs

The Super Hole-A-Matic post hole digger digs holes—at any angle—from four to eight inches in diameter, up to six feet deep, with a shaft extension. The specially de-

Digging holes faster.

signed hardened alloy steel blades work with a pulverizing, grinding action. Chews up soft shale and rides above large rocks without damage. Powered by 110 volt AC or DC current. More data from Multi-Matic Corp., Box 2143, Van Nuys, California.

Use coupon on page 32; circle No. 9-19

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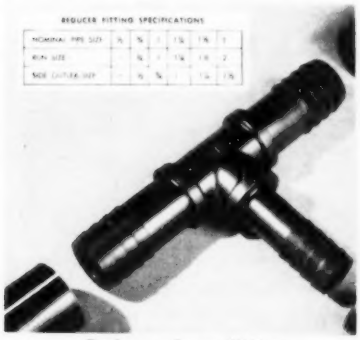
Fittings for Connecting Flexible Plastic Piping

In this reducer tee insert fitting, the side outlet is one standard pipe size smaller than the run. It is available in run sizes from $\frac{3}{4}$ inch to two inches. The fitting is made of ther-



Carlon reducer fitting

moplastic material and is resistant to rot, rust and electrolytic corrosion. Connection with the plastic pipe is made by inserting the fitting and tightening a stainless steel clamp over the pipe and the fitting. Data from Carlon Products Corp., 10225 Meech Ave., Cleveland 5, O.

Use coupon on page 32; circle No. 9-20

• • •

High-Capacity Steam Cleaning Machine

This equipment is capable of discharging 150 gallons of balanced cleaning solution at pressures ranging from 30 psi to 100 psi. It reaches full working pressure in two minutes from a cold start. Oil or gas fired; electrically or gasoline engine driven; portable, stationary or trailer models available. Full information about Model LH available from Clayton Manufacturing Company, Box 550, El Monte, California.

Use coupon on page 32; circle No. 9-21

• • •

Greasing Unit Pumps Grease from the Drum to Equipment

The problem of getting grease from the drum to the bearing is

For greasing equipment

Now's the time to mail this month's Reader's Service card.

INDEX OF ADVERTISEMENTS

solved by the Greasemaster Senior. It is particularly useful to owners and operators of mobile tools and commercial vehicles. The machine operates on a hydraulic ram pump which is powered by an ordinary automotive storage battery. The ram forces grease from the drum through a hose to a universal grease gun handle where pressures can be varied as required. More details from G & T Industries, 1420 Barwise, Wichita, Kansas.

Use coupon on page 32; circle No. 9-22

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Honor for Supt. Wendell La Due

The National Safety Council has announced, in giving that department its award of honor for the year 1952, that a job with the Akron, Ohio, water department is the safest municipal one to be had. The department personnel had only one lost-time accident that year, a rate of 2.2 injuries per million man-hours worked. It is the first time any branch of government has received this award.

• • •

Milwaukee Has Openings for Engineers

Experienced structural engineers are needed by the City of Milwaukee, Wisc., in connection with a $7 million bridge program. Salary ranges $5098 to $5722 and $5910 to $6534. Write O. B. Blix, City Service Commission, City Hall, Milwaukee 2, Wisc.

• • •

The Cost of Swimming Pools

The National Recreation Association reports that the cost of 22 outdoor pools, without bathhouses but with filtration and chlorination equipment, averaged $12.45 per sq. ft. of water surface. The average cost of 60 pools with bathhouses was $16.61 per sq. ft. of water surface.

Worth Telling

by Arthur K. Akers

★ **AMERICAN CAST IRON PIPE COMPANY,** Birmingham announces election of ARNOLD J. HERRMANN as vice-president, sales, to succeed

Mr. Herrmann

Mr. MacKay

LESTER LONG, retired. J. W. MacKAY succeeds Herrmann as assistant general sales manager.

★ **99-YEAR OLD SHUNK MANUFACTURING COMPANY,** Bucyrus, Ohio, celebrates its coming centennial with start of a $400,000 expansion and modernization of plant program. High carbon cutting edges for highway equipment is their feature in the public works field.

★ **HARRY S. PRICE Jr,** vice-president of PRICE BROTHERS COMPANY, Dayton, sends us a hundred dollars—just like that. It's a "Texas" $100 bill, and like all Texas products is five times the size of ordinary money. All hooked to a smart promotional piece on Price water pipe.

★ **B-I-F INDUSTRIES** is the new name with which Builders Iron Foundry Providence, starts its second century of corporate existence. These include BUILDERS-PROVIDENCE, INC., PROPORTIONEERS, INC., and OMEGA MACHINE COMPANY.

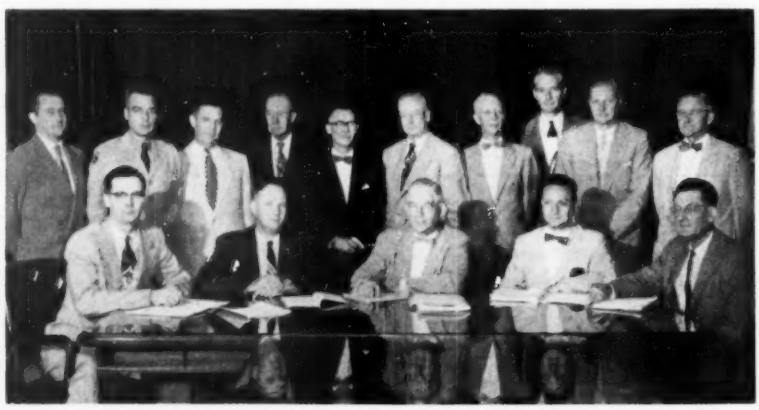
★ **S. X. BESSEN** is a late addition at the KOMLINE - SANDERSON ENGINEERING CORPORATION (Coilfilters) in Peapack, N. J. He was formerly with OLIVER UNITED FILTERS and CHICAGO PUMP COMPANY.

★ **DR. J. V. N. DORR,** founder and chairman of the board of The DORR COMPANY, ENGINEERS, Stamford, Conn., announces election of J. DELANO HITCH, Jr., as president.

Mr. Hitch

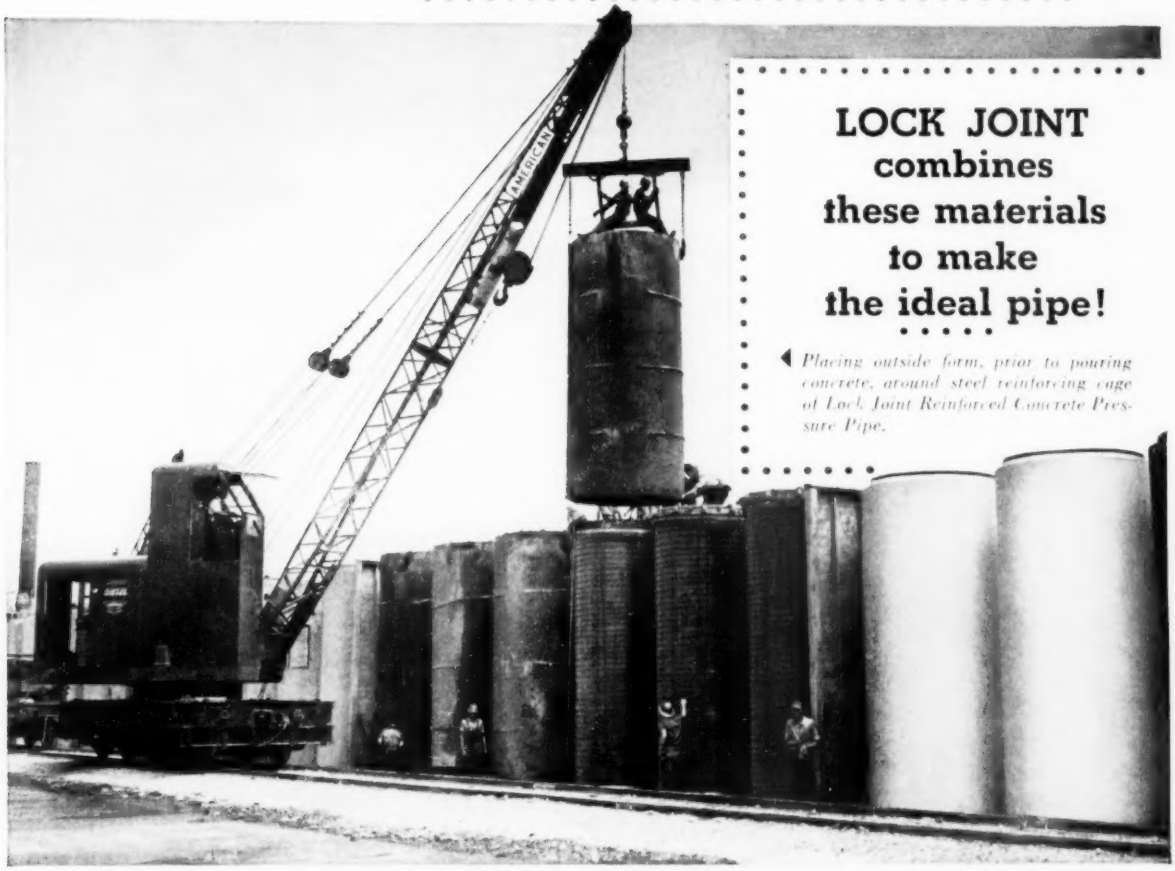
★ **"WERE THERE** any powder marks on the body of your dead husband?" the coroner asked.

"Certainly there were powder marks," replied the widow. "That's why I shot him."



★ **YOU WILL BE INTERESTED** in this group picture taken in Washington in July of the Joint Committee for the Advancement of Sanitary Engineering. Standing, l to r: Don Reynolds, Lt. Col. Stanley Weidenkopf, Ray Lawrence, W. A. Hardenbergh, J. E. Kiker, Wendell LaDue, R. S. Rankin, R. E. Stiemke, Clarence Sterling, and Thomas Camp. Seated, l to r: Dwight Metzler, Rolf Eliassen, Earnest Boyce, Ralph Furhman, and A. H. Wieters. See p. 26.

There's no substitute for CONCRETE and STEEL!



LOCK JOINT combines these materials to make the ideal pipe!

Placing outside form, prior to pouring concrete, around steel reinforcing cage of Lock Joint Reinforced Concrete Pressure Pipe.

CONCRETE, with its proven qualities of durability, non-corrosion, resistance to electrolytic action, and high compressive strength is combined, by Lock Joint, with steel's toughness, resilience and high tensile strength to make a pipe that retains the best qualities of both—non tuberculance, high structural strength and long life with little or no maintenance. Dense concrete affords complete protection for the quality reinforcing steel. Both materials are carefully calculated to meet your pressure needs with a wide factor of safety. The Lock Joint Pipe Company's Rubber and Steel Joint is extremely watertight and, at the same time, flexible.

For superior strength, carrying characteristics and trouble-free operation, let Lock Joint supply your pipe needs in sizes 16" and larger.

SCOPE OF SERVICES—*Lock Joint Pipe Company specializes in the manufacture and installation of Reinforced Concrete Pressure Pipe for Water Supply and Distribution Mains 16" in diameter or larger, as well as Concrete Pipes of all types for Sanitary Sewers, Storm Drains, Culverts and Subaqueous Lines.*

LOCK JOINT PIPE COMPANY

Established 1905

P. O. Box 269, East Orange, N. J.

PRESSURE PIPE PLANTS: Wharton, N. J., Turner, Kan., Detroit, Mich., Columbia, S. C.

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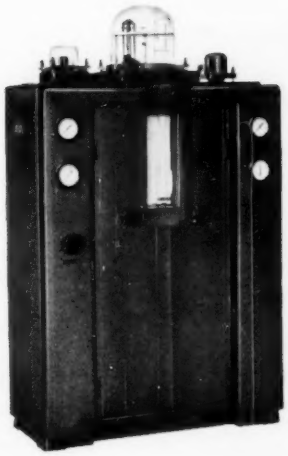
LOCK JOINT
Reinforced Concrete
PRESSURE PIPE

well "founded" beauty...

The Eiffel Tower's 984 feet of delicate, graceful beauty has stood the test of time because the interlaced ironwork structure is firmly anchored to four concrete corner-foundations.

with W&T Chlorinators, too.....



. . . Both the beauty of their smooth, modern lines and their time-proved, always dependable accuracy are well founded in the essentials of reliable equipment: — adequate research and development, a trained field staff, modern manufacturing techniques and a full line of designs to meet every need.

Take, for example, the reseach and development staff. Trained chemists and engineers are working continually to solve new problems with chlorination: to improve existing processes; and to design new equipment and controls. This staff is behind each W&T Chlorinator — your assurance you will get the *best in equipment* and the latest in plant processes.

WALLACE & TIERNAN
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